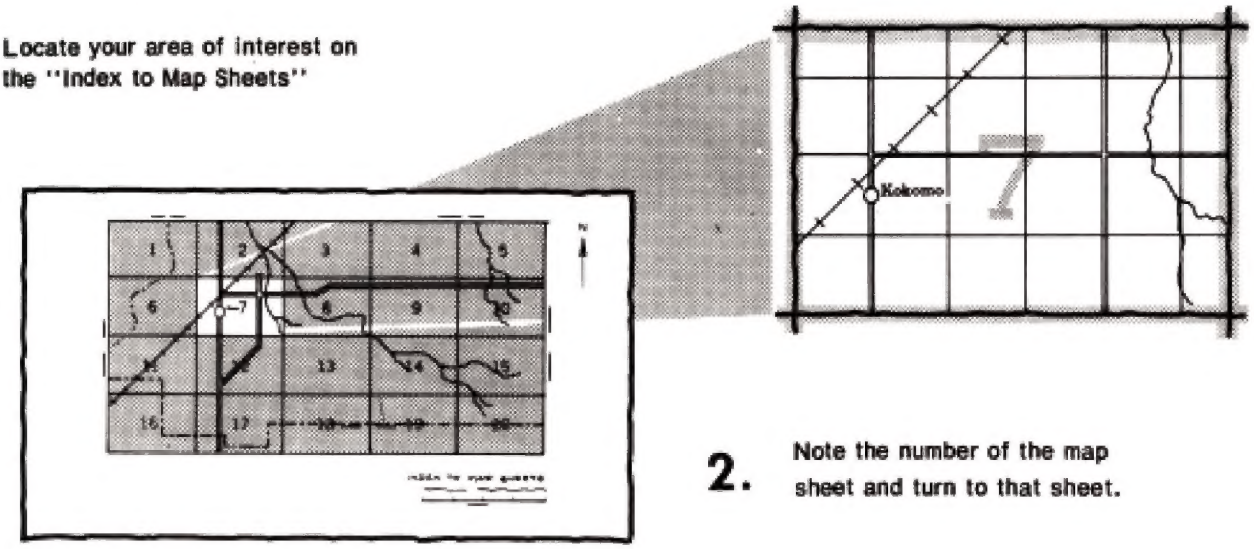
Soil Survey Of

Grayson County, Texas

United States Department of Agriculture
Soil Conservation Service
in cooperation with
Texas Agricultural Experiment Station

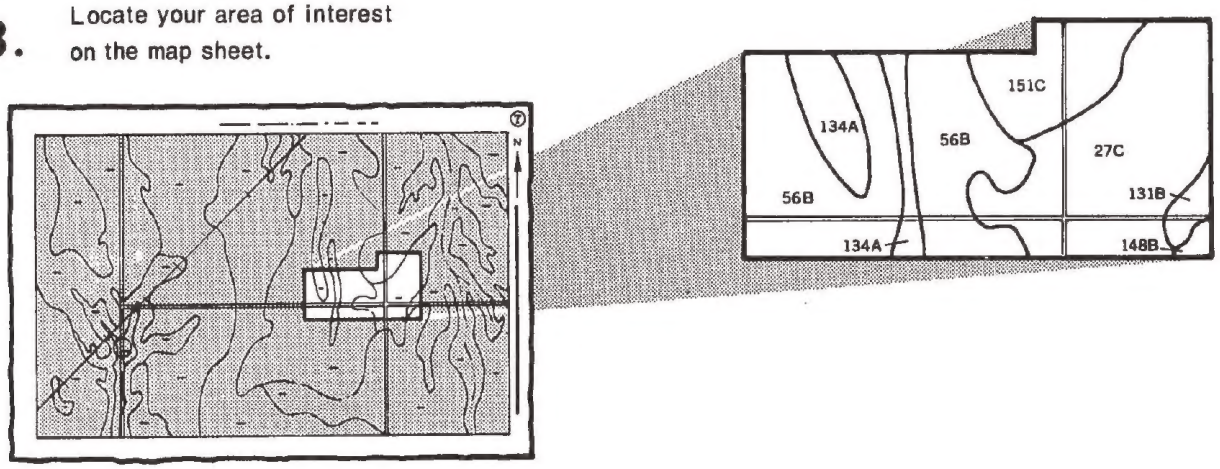
HOW TO USE

1. **Locate your area of interest on the "Index to Map Sheets"**

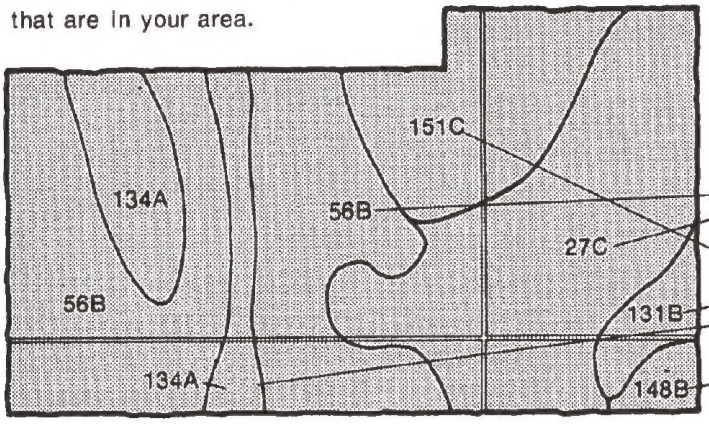


2. **Note the number of the map sheet and turn to that sheet.**

3. Locate your area of interest on the map sheet.



4. List the map unit symbols that are in your area.

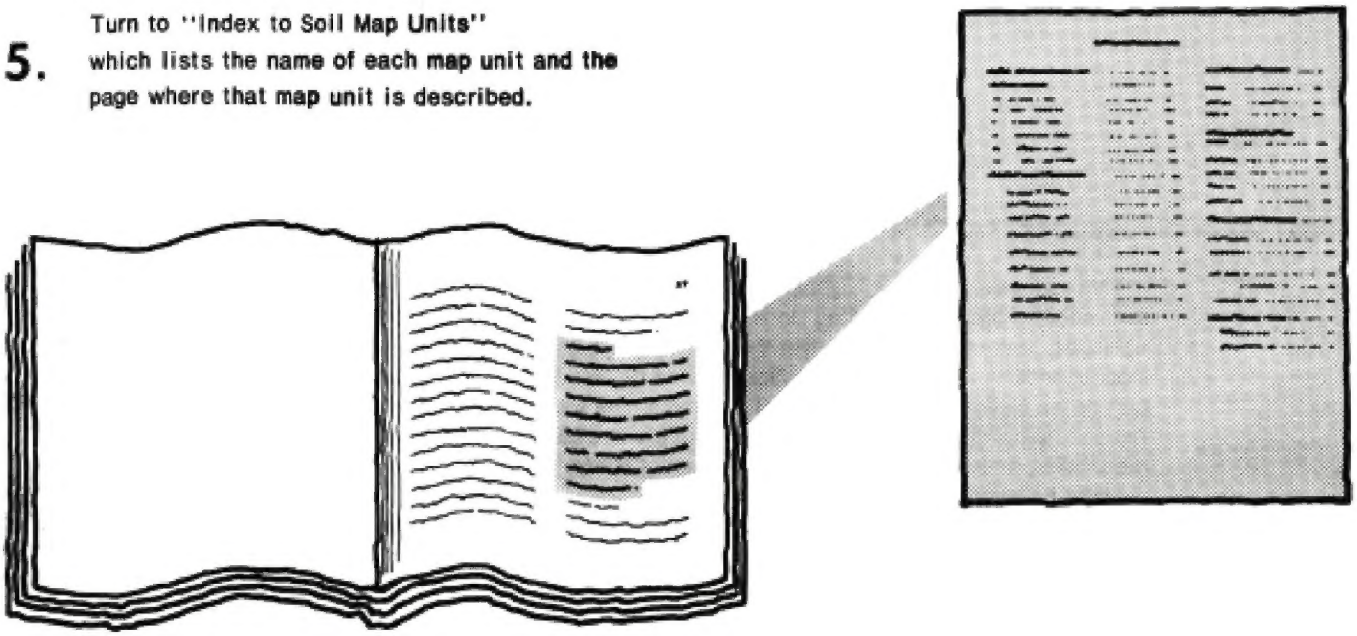


Symbols

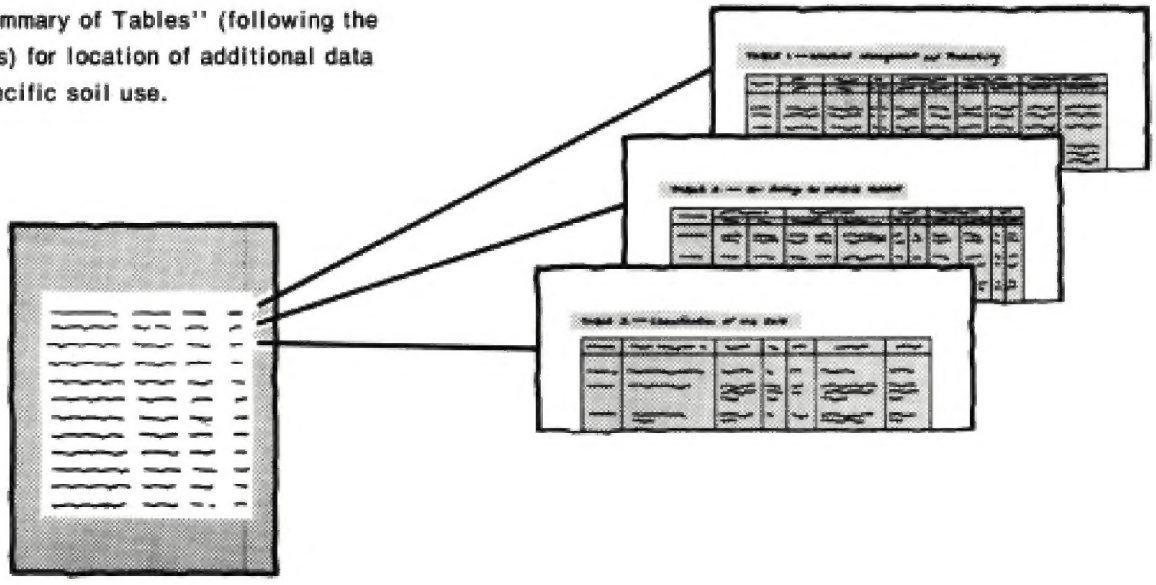
27C
56B
131B
134A
148B
151C

THIS SOIL SURVEY

5. Turn to "Index to Soil Map Units" which lists the name of each map unit and the page where that map unit is described.



6. See "Summary of Tables" (following the Contents) for location of additional data on a specific soil use.



7. Consult "Contents" for parts of the publication that will meet your specific needs. This survey contains useful information for farmers or ranchers, foresters or agronomists; for planners, community decision makers, engineers, developers, builders, or homebuyers; for conservationists, recreationists, teachers, or students; to specialists in wildlife management, waste disposal, or pollution control.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal agencies, state agencies including the Agricultural Experiment Stations, and local agencies. The Soil Conservation Service has leadership for the federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all, regardless of race, color, national origin, sex, religion, marital status, or age.

Major fieldwork for this soil survey was performed in the period 1966-76. Soil names and descriptions were approved in 1977. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1977. This survey was made cooperatively by the Soil Conservation Service and the Texas Agricultural Experiment Station. It is part of the technical assistance furnished to the Upper Elm-Red and Collin County Soil and Water Conservation Districts.

Soil maps in this survey may be copied without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. If enlarged, maps do not show the small areas of contrasting soils that could have been shown at a larger scale.

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Issued February 1980

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Summary of tables

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Foreword

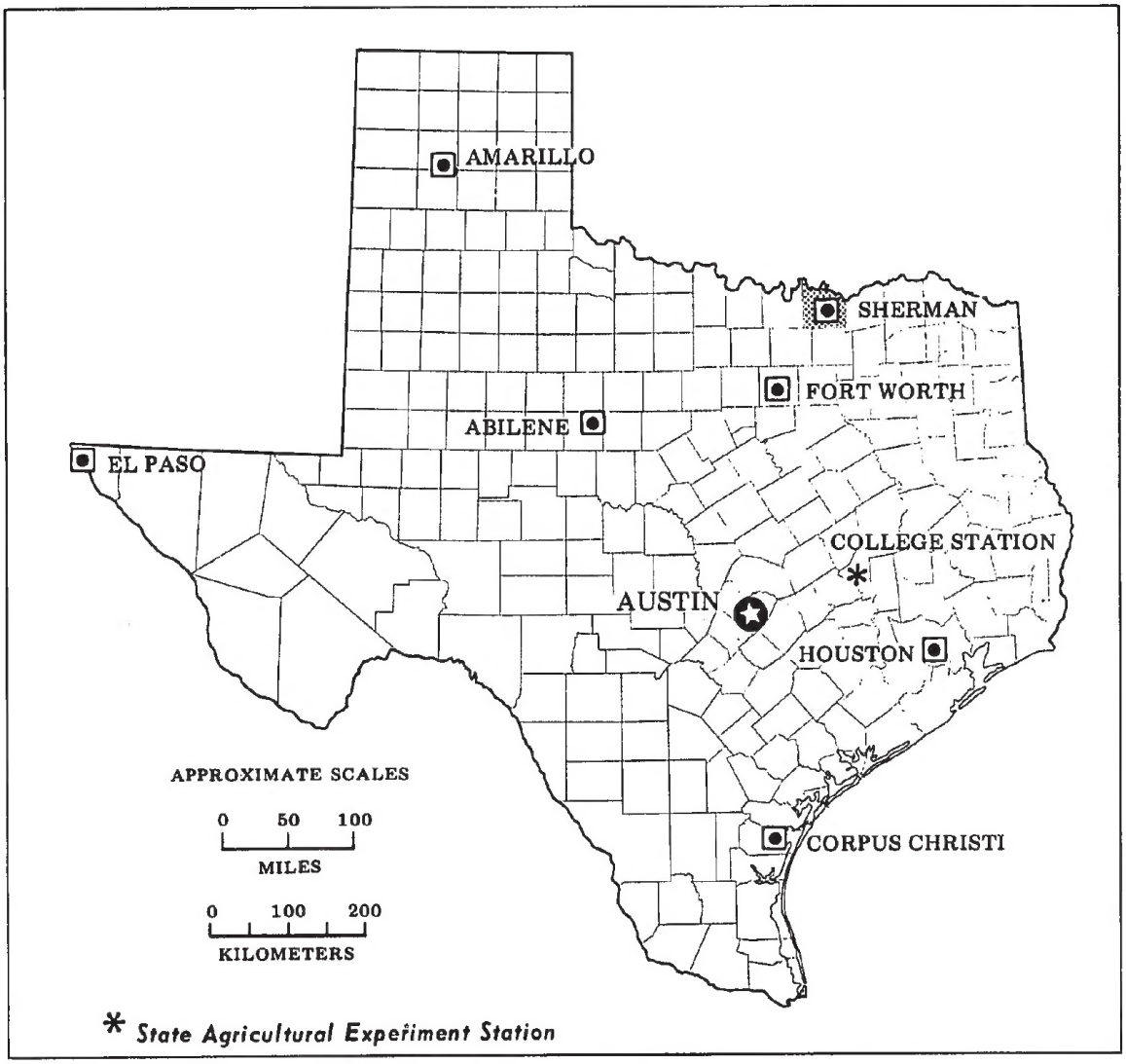
This soil survey contains information that can be used in land-planning programs in Grayson County. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, ranchers, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to insure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Soil Conservation Service or the Cooperative Extension Service.

George C. Marks
State Conservationist
Soil Conservation Service



Location of Grayson County in Texas.

SOIL SURVEY OF GRAYSON COUNTY, TEXAS

By Rex Cochran, Soil Conservation Service

Soils surveyed by Rex Cochran, Charles Cail, and Lee Putnam, Soil Conservation Service

United States Department of Agriculture, Soil Conservation Service, in cooperation with Texas Agricultural Experiment Station

Grayson County is in the north-central part of Texas. It is in the Cross Timbers and Texas Blackland Prairie Resource Areas.

The county is trapezoidal in shape. It is about 52 miles west to east. The eastern part is about 36 miles north to south, and the western part is about 60 miles. The county covers 984 square miles, or 629,760 acres. Water areas are made up of 28,160 acres of water, most of which is in Lake Texoma. The elevation varies from 500 to 800 feet above sea level. The northern part of the county is drained by the Red River, and the southern part is drained by tributaries of the Trinity River.

Sherman is the county seat of Grayson County. It is near the center of the county. Denison is about 10 miles north of Sherman, and together these two cities are known as "twin cities." Major towns and communities in the county are Whitesboro, Whitewright, Van Alstyne, Howe, Pottsboro, Bells, Tom Bean, Collinsville, Tioga, and Gunter.

In 1970, the total population of the county was 83,225. The population of Sherman was about 30,000, and the population of Denison was about 25,000.

The western and northern parts of the county consist of timbered savannah. The soils in these parts are mainly gently undulating to gently rolling, moderately deep and deep, and sandy and loamy. They formed under grasses and hardwoods. In many areas the soils are eroded, and gullies are common. The rest of the county consists of open prairie. The soils are mainly gently undulating to steep, shallow to deep, and clayey and loamy. They formed in chalky limestone, shale, and limestone under grasses.

The Red River and Lake Texoma form the northern border of the county. The northern half of the county is in the Red River watershed. The rest of the county is in the Trinity River watershed where many flood-control structures help control flooding and prevent erosion.

General nature of the county

The history, industry, transportation, natural resources, and climate of the county are briefly described in this section.

History

Grayson County was formed and organized in 1846. It was formed from Fannin County. It was named for Republic of Texas Attorney General Peter W. Grayson. The area that is now known as Preston Bend along the Red River was the first area settled. John Hart, John S. Baker, and William R. Baker, trappers and traders, settled the area in 1837.

Denison is noted as the birthplace of President Dwight D. Eisenhower. Also, it is the site of Denison Dam, which forms Lake Texoma, a major recreation area between Texas and Oklahoma.

Industry

Farming and ranching are the major enterprises in the county. The county is about 45 percent cropland, 48 percent rangeland, 4.5 percent water, and 2.5 percent urban land, farmsteads, and miscellaneous area. Cotton, grain sorghum, wheat, and peanuts are the main cultivated crops. Beef cattle is the main ranch stock.

The Sherman-Denison Standard Metropolitan Statistical Area ranks twentieth in the State in size. Numerous large and small manufacturing plants employ a majority of the nonfarm population. In the survey area are plants that manufacture foodstuffs, business forms, electronic products, ferrous and aluminum castings, truck bodies, office equipment, surgical supplies, plastics, clothing, and other goods. Denison is a major railroad center and has an extensive yard and repair facility. Other sources of employment in the county are the various shops and retail stores in the many towns and shopping centers.

Transportation

Grayson County is served by a network of good highways. Four United States highways cross the county. U.S. Highway 82 runs east and west, and U.S. Highways 69, 377, and 75 run north and south. A network of farm roads and Texas highways connect the towns and cities.

The county is crossed by four railroads that provide transportation inside and outside the survey area. Buslines operate regularly scheduled services to the county.

The county operates an airport and industrial complex at old Perrin Air Force Base; however, regularly scheduled airline flights are not available from Grayson County.

Natural resources

The soil is a valuable resource in Grayson County. Farming and livestock operations, which are directly influenced by the soil properties, provide the livelihood of many people. Also, petroleum and natural gas are major resources. Their production provides income for many landowners and is very important to the overall economy of the entire county. Sand and gravel pits in the county furnish materials for construction of roads and for other uses. Lake Texoma is a major water resource for the county. It also provides recreation and helps control flooding of the Red River.

Climate

Prepared by the National Climatic Center, Asheville, North Carolina.

Grayson county is hot in summer and mild in winter. In winter, an occasional surge of cold air causes a sharp drop in temperatures. Rainfall is uniformly distributed throughout the year, reaching a slight peak in spring. Snowfall is infrequent. The total annual precipitation is normally adequate for production of cotton, feed grains, and small grain.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Sherman in the period 1951 to 1975. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter the average temperature is 44 degrees F, and the average daily minimum temperature is 33 degrees. The lowest temperature on record, which occurred at Sherman on February 2, 1951, is 2 degrees. In summer the average temperature is 82 degrees, and the average daily maximum temperature is 93 degrees. The highest recorded temperature, which occurred on July 25, 1954 is 109 degrees.

Growing degree days are shown in table 1. They are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (50 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

Of the total annual precipitation, 24 inches, or 60 percent, usually falls in April through September, which includes the growing season for most crops. In 2 years out of 10, the rainfall in April through September is less than 17 inches. The heaviest 1-day rainfall during the period of record was 5.7 inches at Sherman on October 31, 1974. Thunderstorms occur on about 50 days each year, and most occur in spring.

Average seasonal snowfall is 3 inches. The greatest snow depth at any one time during the period of record was 7 inches. On an average, 1 day has at least 1 inch of snow on the ground. The number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 60 percent. Humidity is higher at night, and the average at dawn is about 80 percent. The sun shines 70 percent of the time possible in summer and 50 percent in winter. The prevailing wind is from the south. Average windspeed is highest, 13 miles per hour, in spring.

Tornadoes and severe thunderstorms occur occasionally. These storms are local and of short duration, and the pattern of damage is variable and spotty.

How this survey was made

Soil scientists made this survey to learn what soils are in the survey area, where they are, and how they can be used. They observed the steepness, length, and shape of slopes; the size of streams and the general pattern of drainage; the kinds of native plants or crops; and the kinds of rock. They dug many holes to study soil profiles. A profile is the sequence of natural layers, or horizons, in a soil. It extends from the surface down into the parent material, which has been changed very little by leaching or by plant roots.

The soil scientists recorded the characteristics of the profiles they studied and compared those profiles with others in nearby counties and in more distant places. They classified and named the soils according to nationwide uniform procedures. They drew the boundaries of the soils on aerial photographs. These photographs show trees, buildings, fields, roads, and other details that help in drawing boundaries accurately. The soil maps at the back of this publication were prepared from aerial photographs.

The areas shown on a soil map are called map units. Most map units are made up of one kind of soil. Some are made up of two or more kinds. The map units in this survey area are described under "General soil map for broad land use planning" and "Soil maps for detailed planning."

While a soil survey is in progress, samples of some soils are taken for laboratory measurements and for engineering tests. All soils are field tested to determine their characteristics. Interpretations of those characteristics may be modified during the survey. Data are assembled from other sources, such as test results, records,

field experience, and state and local specialists. For example, data on crop yields under defined management are assembled from farm records and from field or plot experiments on the same kinds of soil.

But only part of a soil survey is done when the soils have been named, described, interpreted, and delineated on aerial photographs and when the laboratory data and other data have been assembled. The mass of detailed information then needs to be organized so that it can be used by farmers, rangeland managers, engineers, planners, developers and builders, home buyers, and others.

General soil map for broad land use planning

The general soil map at the back of this publication shows broad areas that have a distinctive pattern of soils, relief, and drainage. Each map unit on the general soil map is a unique natural landscape. Typically, a map unit consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one unit can occur in other units but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one map unit differ from place to place in slope, depth, drainage, and other characteristics that affect management.

The soils in the survey area vary widely in their potential for major land uses. Table 4 shows the extent of the map units shown on the general soil map. It lists the potential of each, in relation to that of the other map units, for major land uses and shows soil properties that limit use. Soil potential ratings are based on the practices commonly used in the survey area to overcome soil limitations. These ratings reflect the ease of overcoming the limitations. They also reflect the problems that will persist even if such practices are used.

Each map unit is rated for *cultivated crops, pasture, range, urban uses,* and *recreation areas*. Cultivated crops are those grown extensively in the survey area. Pasture refers to land that is planted to tame grasses and intensively managed. Range refers to land used for production of native grasses. Urban uses include residential, commercial, and industrial developments. Recreation areas are campsites, picnic areas, ballfields, and other areas that are subject to heavy foot traffic.

Land area of the nine soil associations in Grayson County makes up about 95 percent of the total acreage in the county. The rest is water area.

Nearly level to strongly sloping, clayey and loamy soils; on uplands

These soils make up about 64 percent of the county. The major soils are Normangee, Crockett, Wilson, Fairlie, Austin, Houston Black, Vertel, Heiden, Sanger, and Bolar.

These soils have a clayey or loamy surface layer and clayey underlying material. They have moderate to very slow permeability. Soils that have a clayey surface layer develop deep, wide cracks on the surface if they become dry, and water enters the soil through these cracks rapidly. If the soil becomes wet, the cracks are sealed, and water enters the soil very slowly. The clayey underlying material has high shrink-swell potential.

Most areas of these soils are cultivated; however, soils in the Sanger-Bolar map unit are used mainly for pasture and range. The major crops are wheat, grain sorghum, and cotton. Bermudagrass and fescue are the main pasture grasses. Range is mixed tall and mid grasses.

1. Normangee-Crockett-Wilson

Deep, very slowly permeable, loamy soils

This map unit consists of nearly level to sloping soils on uplands. Slope is 0 to 8 percent.

This map unit makes up about 27 percent of the county. It is about 30 percent Normangee soils, 27 percent Crockett soils, 20 percent Wilson soils, and 23 percent soils of minor extent.

The Normangee soils are on slight ridges and side slopes of valleys. They have a surface layer of dark grayish brown, medium acid clay loam about 7 inches thick. Below this to a depth of 55 inches is clay that is in shades of brown and has mottles of various colors. The clay is medium acid in the upper part and moderately alkaline below a depth 45 inches. Between depths of 55 and 65 inches is mottled olive, yellow, and grayish brown, moderately alkaline shaly clay.

The Crockett soils are gently sloping on ridges and side slopes. They have a surface layer of dark grayish brown, medium acid loam about 4 inches thick. Below this to a depth of 65 inches is clay in shades of brown. The clay is slightly acid in the upper part and moderately alkaline in the lower part.

The Wilson soils are nearly level and gently sloping in broad areas. They have a surface layer of dark gray, medium acid silty clay loam about 8 inches thick. Below this to a depth of 80 inches is silty clay in shades of gray. The clay has mottles below a depth of 58 inches. It is neutral or mildly alkaline.

Of minor extent in this unit are the gently sloping Callisburg and Crosstell soils on broad uplands; the Bunyan and Whitesboro soils on bottom lands; and the Gasil soils on convex side slopes of ridges. Other soils of minor extent are the Heiden and Vertel soils on the side slopes of broad ridges and the Mabank soils on broad, low lying flats. Some Urban land is also in areas of this unit.

The soils in this map unit are used for cultivated crops and for pasture. The main crops are small grain, grain sorghum, and cotton. Some areas of cropland are being converted to improved pasture.

These soils have high potential for pasture and medium potential for cultivated crops. They have medium potential for urban development. The very slow permeability in the clayey lower layers is a limitation for septic tank filter fields; also, the shrink-swell potential is high. These soils have medium potential for recreation development.

2. Fairlie-Austin-Houston Black

Moderately deep and deep, moderately slowly permeable and very slowly permeable, clayey soils

This map unit consists of nearly level to gently sloping soils on uplands. Slope is mainly 0 to 5 percent.

This map unit makes up about 24 percent of the county. It is about 27 percent Fairlie soils, 20 percent Austin soils, 15 percent Houston Black soils, and 38 percent soils of minor extent.

The Fairlie soils are nearly level to gently sloping on uplands. They have a surface layer of very dark gray, moderately alkaline clay about 15 inches thick. Below this to a depth of 46 inches is brownish, moderately alkaline clay. Below a depth of 46 inches is white, platy chalk.

The Austin soils are gently sloping on side slopes of ridges. They have a surface layer of dark grayish brown, moderately alkaline silty clay about 11 inches thick. Below this to a depth of 22 inches is grayish, moderately alkaline silty clay, and below that to a depth of 30 inches is grayish, moderately alkaline silty clay loam. Below a depth of 30 inches is white, platy chalk.

The Houston Black soils are nearly level to gently sloping on uplands. They have a surface layer of very dark gray, moderately alkaline clay about 17 inches thick. Below this to a depth of 65 inches is brownish, moderately alkaline clay.

Of minor extent in this unit are the gently sloping Heiden soils on side slopes of ridges; the gently sloping Lewisville soils on old, high stream terraces; the gently sloping Stephen soils on uplands in areas of Fairlie and Houston Black soils; and the Altoga soils on side slopes above major streams. Other soils of minor extent are the gently sloping Crockett and Normangee soils on upland ridges; the gently sloping and sloping Eddy, Howe, and Whitewright soils on side slopes of ridges; and the Elbon and Trinity soils on bottom lands. Also of minor extent are the gently sloping Speck Variant soils on ridgetops; the sloping Vertel soils on the side slopes of ridges; and the Wilson soils in broad, flat areas.

The soils in this map unit are used mainly for cultivated crops. The major crops are small grain, grain sorghum, and cotton.

These soils have high potential for cultivated crops, range, and pasture. They have low potential for urban development. The high shrink-swell potential is the main limitation. These soils have low potential for septic tank filter fields and for recreation uses. The clayey surface layer is the main limitation for recreation uses.

3. Vertel-Heiden

Moderately deep and deep, very slowly permeable, clayey soils

This map unit consists of soils on convex slopes and ridges on uplands.

This map unit makes up about 11 percent of the county. It is about 40 percent Vertel soils, 35 percent Heiden soils, and 25 percent soils of minor extent.

The Vertel soils are on ridges and upper convex side slopes. They have a surface layer of grayish brown, mildly alkaline clay about 5 inches thick. Below this to a depth of 33 inches is olive, moderately alkaline clay. Below a depth of 33 inches is shale in shades of brown and gray.

The Heiden soils are on side slopes of drains. They have a surface layer of dark grayish brown, moderately alkaline clay 14 inches thick. Below this to a depth of 50 inches is moderately alkaline clay that is in shades of brown and olive and has mottles below a depth of 40 inches. Between the depths of 50 and 60 inches is mottled, moderately alkaline shaly clay.

Of minor extent in this unit are the Crockett, Crosstell, and Normangee soils on broad convex ridges on uplands; the Elbon and Trinity soils on bottom lands; and the Mabank soils in broad, low lying flat areas.

The soils in this map unit are used mainly for pasture and cultivated crops. Small grain is the major crop.

These soils have medium potential for pasture and cultivated crops and high potential for range. Erosion is a hazard to cultivated crops. These soils have low potential for urban development. The high shrink-swell potential and clay texture are major limitations. These soils have low potential for recreation uses. The clayey surface layer is the main limitation.

4. Sanger-Bolar

Deep and moderately deep, very slowly permeable and moderately permeable, clayey and loamy soils

This map unit consists of gently sloping to strongly sloping soils on ridges and side slopes on uplands.

This map unit makes up about 2 percent of the county. It is about 41 percent Sanger soils, 25 percent Bolar soils, and 34 percent soils of minor extent.

The Sanger soils are gently sloping on side slopes of ridges. They have a surface layer of very dark gray, moderately alkaline clay about 7 inches thick. Below this to a depth of 49 inches is moderately alkaline clay that is in shades of brown and olive and has mottles below a depth of 23 inches. Between depths of 49 and 65 inches is mottled, moderately alkaline shaly clay.

The Bolar soils are on convex ridges and convex side slopes of ridges. They have brownish, moderately alka-

line clay loam to a depth of 33 inches. Below this to a depth of 37 inches is gray, moderately alkaline shaly clay. The underlying material is hard, slightly fractured limestone.

Of minor extent in this unit are the gently sloping Aledo soils on broad uplands and on breaks along Lake Texoma; the gently sloping Callisburg and Crosstell soils on convex ridges; and the gently sloping Lindy soils on uplands. Other soils of minor extent are the Purves soils on convex side slopes and tops of ridges; the Bunyan and Whitesboro soils on bottom lands; and the Wilson soils on side slopes of valleys.

The soils in this map unit are mainly used for pasture and for range. Some areas are used for small grain.

These soils have high potential for range. They have medium potential for pasture and cultivated crops. Erosion is a hazard, and slope is a limitation for pasture and cultivated crops. These soils have low potential for urban development and for recreation uses. The high shrink-swell potential and very slow permeability are the main limitations.

Gently sloping to strongly sloping, loamy and sandy soils; on uplands

These soils make up about 26 percent of the county.

The major soils are Gasil, Callisburg, Crosstell, Howe, Whitewright, Eddy, and Aubrey.

These soils have a surface layer of fine sandy loam or loamy fine sand and an underlying layer that is loamy or clayey. They are moderately permeable to very slowly permeable.

Most areas of these soils are used for pasture and range. Some areas are used for cultivated crops. Many of the areas are covered with oak, winged elm, and persimmon trees and scattered patches of grasses. The grasses are mainly tall and mid grasses. The major crop is peanuts. Improved bermudagrasses are the main pasture grasses.

5. Callisburg-Crosstell-Gasil

Deep, moderately permeable to very slowly permeable, loamy and sandy soils

This map unit consists of gently sloping to sloping soils on uplands. Slope is mainly 1 to 8 percent.

This unit makes up about 16 percent of the county. It is about 21 percent Callisburg soils, 20 percent Crosstell soils, and 16 percent Gasil soils. The rest is soils of minor extent.

The Callisburg soils are in valleys, on low ridges, and on side slopes and foot slopes of ridges. They have a surface layer of pale brown, neutral fine sandy loam about 5 inches thick. Below this to a depth of 62 inches is mottled, medium acid to neutral sandy clay.

The Crosstell soils are on ridges and on convex upper slopes of ridges. They have a surface layer of pale brown, neutral fine sandy loam about 3 inches thick. Below this to a depth of 43 inches is mottled, strongly acid and very strongly acid clay. Between depths of 43 and 60 inches is mottled, mildly alkaline shaly clay.

The Gasil soils are on side slopes of ridges. They have a surface layer of brownish loamy fine sand about 10 inches thick. The surface layer is medium acid in the upper part and slightly acid in the lower part. Below this is brownish and yellowish sandy clay that is medium acid to a depth of about 22 inches and is strongly acid below.

Of minor extent in this map unit are the Aubrey, Birome, and Heaton soils on the side slopes of ridges; the Bastrop soils in gently sloping areas; and the Bunyan, Whitesboro, and Elbon soils on bottom lands. Other soils of minor extent are the gently sloping Crockett, Normangee, and Wilson soils on side slopes of ridges; the Heiden soils on convex ridges; and the Mabank soils in broad flat areas.

The soils in this map unit are used mainly for pasture and for cultivated crops. The major crop is peanuts.

These soils have medium potential for pasture and range. They have medium potential for cultivated crops because of slope and the hazard of erosion. These soils have medium potential for urban and recreation uses. Scenic topography and oak trees are attractions for urban development, but high shrink-swell potential is a main limitation. Very slow permeability and the sandy surface layer limit recreation use.

6. Whitewright-Howe-Eddy

Very shallow to moderately deep, moderately permeable and moderately slowly permeable, loamy soils

This map unit consists of gently sloping to strongly sloping soils on ridges and convex side slopes. Slope is mainly 1 to 12 percent.

This map unit makes up about 8 percent of the county. It is about 27 percent Whitewright soils, 27 percent Howe soils, 22 percent Eddy soils, and 24 percent soils of minor extent.

The Whitewright soils are on side slopes of ridges. They have grayish and brownish, moderately alkaline silty clay loam to a depth of about 16 inches. Below this is platy chalk.

The Howe soils are on side slopes of ridges. They have brownish and grayish, moderately alkaline silty clay loam to a depth of about 26 inches. Below this is white, platy chalk.

The Eddy soils are on ridgetops and side slopes of ridges. They have light brownish gray, moderately alkaline gravelly and very gravelly clay loam to a depth of about 13 inches. Below this to a depth of 16 inches is platy chalk; the chalk is massive below a depth of 16 inches.

Of minor extent in this map unit are the gently sloping Altoga and Lewisville soils in areas above bottom lands; the Stephen soils on convex ridgetops; and the Fairlie, Austin, Heiden, and Houston Black soils on broad ridges on uplands.

The soils in this map unit are used mainly for pasture.

These soils have low potential for pasture. Improved bermudagrasses are suited to these soils. These soils have low potential for cultivated crops because of the slope, rooting depth, and hazard of erosion. These soils have medium potential for urban development. The depth to rock and shrink-swell potential are the main limitations. These soils have medium potential for recreation uses.

7. Aubrey

Moderately deep, slowly permeable, loamy soils

This map unit consists of soils on ridgetops and on convex, strongly sloping, upper side slopes of ridges. Slope is mainly 3 to 12 percent.

This map unit makes up about 2 percent of the county. It is about 85 percent Aubrey soils and 15 percent soils of minor extent.

The Aubrey soils are on slightly convex side slopes of ridges. Ironstone and sandstone fragments from 3 to 30 inches across the long axis cover 1 to 30 percent of the surface. These soils have a surface layer of brownish, neutral, stony fine sandy loam about 6 inches thick. Below this to a depth of 32 inches is red, extremely acid clay that has contrasting mottles, and to a depth of 48 inches is mottled, extremely acid shaly clay. Between depths of 48 to 60 inches is mottled, very strongly acid shale.

Of minor extent in this unit are the Callisburg, Crosstell, and Gasil soils on lower side slopes of ridges.

The soils in this map unit are used mainly for range and for wildlife habitat.

These soils have low potential for range and cultivated crops. Most areas are covered with oaks and have stones on the surface. These soils have medium potential for urban development. The large stones, high shrink-swell potential, and slow permeability are the major limitations. The rolling topography and oak woods make this unit attractive to builders and homeowners. These soils have medium potential for recreation development.

Nearly level to gently sloping, clayey and loamy soils; on terraces and bottom lands

These soils make up about 5 percent of the county. Major soils are Elbon, Trinity, Bastrop, Okay, Oklared, and Redlake.

Most areas of these soils are used for pasture. Improved bermudagrasses are the main pasture grasses. Some areas are not suited to urban development because flooding is a hazard.

8. Elbon-Trinity-Redlake

Deep, moderately slowly permeable and very slowly permeable, clayey soils

This map unit consists of soils on flood plains along major streams in the county. Slope is 0 to 1 percent.

This map unit makes up about 3 percent of the county. It is about 57 percent Elbon soils, 18 percent Trinity soils, 10 percent Redlake soils, and 15 percent soils of minor extent.

The Elbon soils are on flood plains of streams. They have brownish and grayish, moderately alkaline clay to a depth of about 65 inches.

The Trinity soils are on flood plains of streams. They have grayish, moderately alkaline clay to a depth of 52 inches. Below this is mottled, moderately alkaline clay.

The Redlake soils are in old backwater sloughs and depressions on flood plains. They have moderately alkaline clay in shades of brown and red to a depth of 60 inches.

The soils of minor extent in this map unit are the gently sloping to sloping Altoga soils on side slopes of valleys; the Zilaboy soils on flood plains; and the Bastrop and Oklared soils on slightly higher terraces.

The soils in this map unit are mainly used for pasture and for cultivated crops.

These soils have high potential for pasture and range. They have high potential for cultivated crops if flooding is not frequent. These soils have low potential for urban development and recreation uses because of flooding.

9. Bastrop-Okay-Oklared

Deep, moderately permeable and moderately rapidly permeable, loamy soils

This map unit consists of nearly level to gently sloping soils on terraces. Slope is mainly 0 to 2 percent.

This map unit makes up about 2 percent of the county. It is about 30 percent Bastrop soils, 13 percent Okay soils, 13 percent Oklared soils, and 44 percent soils of minor extent.

The Bastrop soils are on high terraces above flood plains. They have a surface layer of reddish brown, neutral loam about 6 inches thick. Below this to a depth of 62 inches is reddish, slightly acid or medium acid clay loam.

The Okay soils are on higher positions than the Bastrop soils. They have a surface layer of brown, mildly alkaline fine sandy loam about 12 inches thick. Below this to a depth of 65 inches is brownish and yellowish, medium acid sandy clay loam.

The Oklared soils are on lower positions than Bastrop soils. They have brownish, moderately alkaline very fine sandy loam to a depth of about 11 inches. Below this to a depth of 74 inches is brownish and reddish, moderately alkaline, stratified loam, fine sandy loam, and loamy fine sand.

Of minor extent in this map unit are the gently sloping Gasil and Konsil soils mainly on uplands along the edges of the unit; the Mabank and Wilson soils in broad, nearly level areas; the gently sloping Callisburg soils on uplands; and the Redlake soils on low concave positions.

The soils in this map unit are mainly used for pasture. Some small areas are used for cultivated crops, mostly small grain.

These soils have high potential for cultivated crops, range, and pasture. Improved bermudagrasses are the major grasses for improved pasture. These soils have high potential for urban development and for recreation uses, except in low areas where flooding is a hazard.

Broad land use considerations

In general, the most important factors influencing land use in Grayson County are the kinds of soil, the extent of slopes, and the depth to rock.

Farmland and rangeland make up about 93 percent of the county. Of this, about 45 percent is cultivated for crops and 48 percent is used for range and improved pasture and wooded areas.

The trend in land use in recent years has been a slight decrease in the acreage used for cultivated crops and a slight increase in the acreage used for improved pasture. There has also been an increase in the acreage used for urban development.

The Fairlie-Austin-Houston Black, the Vertel-Heiden, the Elbon-Trinity-Redlake, and the Bastrop-Okay-Oklared map units generally have high potential for cultivated crops and improved pasture. The soils in these units are deep, loamy or clayey, and well suited to cultivated crops. The Bastrop-Okay-Oklared map unit has high potential for urban development and recreation uses, except in low areas where flooding is a hazard. The Aubrey map unit has low potential for most uses. In this unit, the large stones, slow permeability, and shrink-swell potential are the main limitations.

The general information in this section and the more detailed information in the following sections can be used as a guide in planning orderly growth and development of the county.

Soil maps for detailed planning

The map units on the detailed soil maps at the back of this survey represent the soils in the survey area. The map unit descriptions in this section, along with the soil maps, can be used to determine the suitability and potential of a soil for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit, or soil, is given under "Use and management of the soils."

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil, a brief description of the soil profile, and a listing of the principal hazards and limitations to be considered in planning management.

This survey has both narrowly defined and broadly defined units. Broadly defined units are more variable in composition than other units but can be interpreted for the expected uses of the soils. They are also indicated by a footnote on the soil legend at the back of this publication.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer or of the underlying material, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the underlying material. They also can differ in slope, stoniness, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Sanger stony clay, 3 to 8 percent slopes, is one of several phases in the Sanger series.

Some map units are made up of two or more major soils. These map units are called soil complexes or undifferentiated groups.

A *soil complex* consists of two or more soils in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Aubrey-Birome complex, 3 to 12 percent slopes is an example.

An *undifferentiated group* is made up of two or more soils that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils in a mapped area are not uniform. An area can be made up of only one of the major soils, or it can be made up of all of them. Aledo soils, hilly, is an undifferentiated group in this survey area.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. The included soils are identified in each map unit description.

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Pits is an example. Miscellaneous areas are shown on the soil maps. Some that are too small to be shown are identified by a special symbol on the soil maps.

Table 5 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils.

1—Aledo gravelly clay loam, 3 to 8 percent slopes. This very shallow to shallow, gently sloping to sloping, loamy soil is on uplands. Areas are oval and range from 3 to 50 acres.

Typically, the surface layer is grayish brown, moderately alkaline gravelly clay loam about 3 inches thick. Below this to a depth of 8 inches is brown, moderately alkaline very gravelly clay loam. Below a depth of 8 inches is slightly fractured limestone.

This soil is well drained. Runoff is rapid. Permeability is moderate, and available water capacity is very low. The hazard of erosion is moderate.

Included with this soil in mapping are small areas of Purves soils and areas of a very shallow, noncalcareous soil. The included soils make up about 15 percent of any area.

Areas of this Aledo soil are used for range. The potential is low for this use and for wildlife habitat. Proper stocking and controlled grazing are needed in management of range. Cultivated crops are not suited because the depth to bedrock is shallow.

This soil has low potential for urban development. The depth to rock is the major limitation and is difficult to overcome. The potential is medium for recreation development. The slope and small stones are limitations.

This soil is in capability subclass VIs and Shallow range site.

2—Aledo soils, hilly. These very shallow to shallow, loamy soils are on breaks along the Red River. Slope is 10 to 30 percent. Areas are long and narrow and range from 40 to several hundred acres.

This undifferentiated group is made up of about 51 percent Aledo soils and soils that are similar to Aledo soils and 49 percent soils of minor extent. The extent of these soils in the mapped areas is not uniform, and the pattern in which the soils occur is not regular.

Typically, the surface layer of an Aledo soil is very dark grayish brown, moderately alkaline very gravelly clay loam about 8 inches thick. It is about 40 percent fragments of limestone. Below a depth of 8 inches is hard, slightly fractured limestone.

The Aledo soils in this unit are well drained. Runoff is rapid. Permeability is moderate, and available water capacity is very low. The hazard of erosion is severe.

Included with these soils in mapping are areas of soils that are deeper than these Aledo soils and areas of soils that are more clayey. Also included are areas of rock outcrop.

Areas of these soils are used for wildlife habitat and for range. The potential is low for these uses. The native vegetation in most areas is Texas oak and winged elm trees and mid and tall grasses. Cultivated crops and improved pasture are not suited to these soils.

These soils have low potential for urban development and recreation uses. The steepness of slope and presence of stones are the major limitations.

These soils are in capability subclass VIIs and Rocky Hills range site.

3—Altoga clay loam, 5 to 8 percent slopes. This deep, sloping, loamy soil is on terraces above major streams. Areas are long and narrow and range from 10 to 180 acres.

Typically, the surface layer is dark grayish brown, moderately alkaline clay loam about 6 inches thick. Below this to a depth of 65 inches is moderately alkaline clay loam. From 6 to 43 inches the clay loam is very pale brown, and from 43 to 65 inches it is light yellowish brown and has about 5 percent visible calcium carbonate.

This soil is well drained. Runoff is medium. Permeability is moderate, and available water capacity is high. The hazard of erosion is severe.

Included with this soil in mapping are small areas of Howe and Lewisville soils. The included soils make up less than 15 percent of any area.

Areas of this Altoga soil are used mainly for range. The potential is high for this use. Proper stocking and controlled grazing are needed in management of range. The potential is low for cultivated crops. Terraces are needed to help control runoff and reduce erosion. Leaving crop residue on the surface of this soil helps improve tilth and reduce erosion. The potential is medium for improved pasture and is low for wildlife habitat.

This soil has medium potential for urban development. The high shrink-swell potential and low strength are the major limitations, but these can be overcome by good design and proper installation of structures. The potential is medium for recreation uses because of the clayey surface layer.

This soil is in capability subclass IVe and Clay Loam range site.

4—Aubrey fine sandy loam, 5 to 8 percent slopes. This moderately deep, sloping, loamy soil is on ridges and side slopes of ridges. Areas are oblong and range from 10 to 90 acres.

Typically, the surface layer is brown, strongly acid fine sandy loam about 4 inches thick. Below this to a depth of 26 inches is very strongly acid, yellowish red clay. From 17 to 26 inches the clay has common, medium, distinct brownish yellow mottles. Between depths of 26 and 38 inches is red, yellowish brown, and gray clayey shale.

This soil is well drained. Runoff is medium. Permeability is slow, and available water capacity is low. The hazard of erosion is severe.

Included with this soil in mapping are small areas of Birome and Callisburg soils. The included soils make up less than 20 percent of any area.

Areas of this Aubrey soil are used mainly for pasture and for range. Oak trees and scattered stands of native grasses are in some areas that have not been disturbed. The potential is low for pasture and range. Common and improved bermudagrasses are the major grasses used to improve pasture.

Proper stocking, controlled grazing, and control of brush are needed in management of range. The potential is low for cultivated crops. Liming is needed to neutralize

the acidity of the soil, and terraces are needed to help control runoff and reduce erosion. The potential is high for wildlife habitat.

This soil has medium potential for urban uses. The moderate shrink-swell potential, corrosivity, and low strength are the major limitations. Good design and proper installation of structures is needed. The potential is low for septic tank filter fields. The potential is medium for recreation development. Slow permeability is the main limitation.

This soil is in capability subclass IVe and Tight Sandy Loam range site.

5—Aubrey-Birome complex, 3 to 12 percent slopes. These gently sloping to strongly sloping soils are on convex stony ridges. Areas are oblong and range from 20 to 400 acres.

This complex is made up of about 60 percent Aubrey soils and soils that are similar to Aubrey soils, 27 percent Birome soils, and 13 percent soils of minor extent. Areas of these soils are so intricately mixed that to separate them at the scale used in mapping was not practical.

The Aubrey soils are on slightly convex side slopes of ridges. Ironstone and sandstone fragments 3 to 30 inches across cover 1 to 30 percent of the surface. Typically, the Aubrey soil has a surface layer of dark yellowish brown, neutral stony fine sandy loam about 3 inches thick. Below this to a depth of 6 inches is light yellowish brown, neutral stony fine sandy loam. From 6 to 32 inches is red, extremely acid clay that has common, coarse, yellowish brown mottles below a depth of 18 inches. From 32 to 48 inches is mottled red, dark brown, and gray, extremely acid shaly clay. Below a depth of 48 inches is very strongly acid shale.

The Birome soils are on convex ridgetops. Ironstone and sandstone fragments 4 to 36 inches across cover 1 to 30 percent of the surface. Typically, the Birome soil has a surface layer of pale brown, slightly acid stony fine sandy loam about 4 inches thick (fig. 1). Below this to a depth of 8 inches is light yellowish brown, slightly acid stony fine sandy loam. From 8 to 25 inches is red, extremely acid clay that has a few strong brown mottles below a depth of 18 inches. From 25 to 31 inches is mottled brown, yellowish brown, and reddish brown, extremely acid clay. Below a depth of 31 inches is dark red and strong brown, extremely acid sandstone.

These Aubrey and Birome soils are well drained. Runoff is rapid. Permeability is slow, and available water capacity is low. The hazard of erosion is moderate.

Included with these soils in mapping are areas of a soil that is shallow over sandstone.

Most areas of these soils are covered with oak trees and scattered patches of native grasses. The potential is low for range. The low available water capacity, acidity, and canopy of trees limit the production of forage. Proper stocking, controlled grazing, and control of brush are needed in management of range. Cultivated crops and improved pasture are not suited because of the large stones. The potential is high for wildlife habitat.

Figure 1.—Profile of Birome stony fine sandy loam.

These soils have medium potential for most urban uses. The moderate shrink-swell potential, low strength, corrosivity, and stones on the surface are major limitations. Good design and proper installation of structures is needed to overcome these limitations. The potential is low for septic tank filter fields. Slow permeability is the main limitation. The potential is medium for recreation uses. The slope and large stones on the surface are major limitations.

These soils are in capability subclass VIe and Sandstone Hill range site.

6—Aubrey-Birome-Urban land complex, 3 to 12 percent slopes. This complex consists of gently sloping

to strongly sloping soils on convex ridges. Areas are oval and range from 10 to 100 acres.

This complex is made up of about 30 percent Aubrey soils, 20 percent Birome soils, 40 percent Urban land, and 10 percent soils of minor extent. Areas of these soils and Urban land are so intricately mixed that to separate them at the scale used in mapping was not practical.

Typically, the Aubrey soil has a surface layer of dark yellowish brown, neutral stony fine sandy loam about 6 inches thick. Below this to a depth of 32 inches is red, extremely acid clay, and below a depth of 32 inches is mottled red, gray, and strong brown, very strongly acid or extremely acid shaly clay.

Typically, the Birome soil has a surface layer of pale brown, slightly acid stony fine sandy loam about 8 inches thick. Below this to a depth of 31 inches is extremely acid clay. To a depth of 25 inches the clay is red, and below a depth of 25 inches it is mottled reddish brown, brown, and yellowish brown. Below 31 inches is dark red and strong brown, extremely acid sandstone.

The soils in this complex are well drained. Runoff is rapid. Permeability is slow, and available water capacity is low. The hazard of erosion is severe.

Urban land consists mainly of single unit dwellings and the adjoining streets, driveways, and sidewalks. Service stations and small shopping centers are in some areas.

The soils in this complex have medium potential for urban uses. The native oak trees and rolling topography are attractive to developers and homeowners. The depth to rock, stones on the surface, and acidity are the major limitations. Erosion is a hazard. Because erosion and these limitations are difficult to overcome, good planning and design of structures is essential. Lawns need additional topsoil and require frequent watering. Slopes need protection from erosion during construction and development of lawns.

This complex is not assigned to a capability subclass or range site.

7—Aubrey soils, 3 to 8 percent slopes, severely eroded. These moderately deep, gently sloping to sloping soils are on side slopes of ridges. Areas are oblong and range from 10 to 50 acres. These soils have gullies that are about 40 to 120 feet apart, 1 to 4 feet deep, and 6 to 30 feet wide. The texture of the surface layer is variable. In some areas the surface layer is a mixture of the original surface layer and the upper part of the subsoil. The extent of these soils in mapped areas is not uniform, and the pattern in which the soils occur is not regular.

Typically, the surface layer of an Aubrey soil is brown, medium acid fine sandy loam about 3 inches thick. Below this to a depth of 23 inches is clay. From 3 to 8 inches the clay is reddish brown and medium acid, and from 8 to 23 inches it is reddish brown and strongly acid and has mottles of brownish yellow and gray. Between depths of 23 and 38 inches is yellowish brown and gray, slightly acid shaly clay.

These soils are well drained. Runoff is rapid, and permeability is slow. Available water capacity is low. The hazard of erosion is severe.

Included with these soils in mapping are areas of eroded Birome, Gasil, and Konsil soils. The included soils make up less than 30 percent of any area.

Areas of these Aubrey soils are used for pasture. The potential is low for this use. Sparse stands of common bermudagrass, threeawn, and silver bluestem are the main grasses. A good cover of grass is needed to protect these soils from erosion. The potential is low for range. Controlled grazing and maintenance of a good cover of grass are needed to help control erosion. The potential is low for cultivated crops. In cropland, the shaping and smoothing of gullies is required, and terraces and diversions are needed to protect the soils from erosion. The potential is medium for wildlife habitat.

These soils have medium potential for most urban uses. The erosion, corrosivity, moderate shrink-swell potential, and low strength are the main limitations. Areas need shaping and smoothing and require protection from erosion during construction. The potential for septic tank filter fields is low because of the slow permeability. The potential for recreation uses is medium. Shaping and smoothing of the gullies is needed before the installation of recreation facilities.

These soils are in capability subclass VIe and Tight Sandy Loam range site.

8—Austin silty clay, 1 to 3 percent slopes. This moderately deep, gently sloping, clayey soil is on uplands. Areas are oval or long and narrow and range from 10 to about 100 acres.

Typically, the surface layer is dark grayish brown, moderately alkaline silty clay about 17 inches thick. Below this to a depth of 38 inches is moderately alkaline silty clay. To a depth of 27 inches the silty clay is grayish brown, and from 27 to 38 inches it is brown. Below a depth of 38 inches is white, platy chalk. The chalk becomes massive at a depth of about 42 inches.

This soil is well drained. Runoff is medium. Permeability is moderately slow, and available water capacity is low. The hazard of erosion is slight.

Included with this soil in mapping are small areas of Stephen, Whitewright, Howe, and Fairlie soils. The included soils make up less than 15 percent of any area.

Areas of this Austin soil are dominantly used for cultivated crops. The potential is high for this use. Leaving crop residue on the surface of this soil helps to control erosion, reduce soil temperature, and conserve moisture. The potential is high for pasture and range. Improved bermudagrasses are well suited to this soil. Proper stocking and controlled grazing are needed in management of range. The potential is medium for wildlife habitat.

This soil has medium potential for most urban development. The shrink-swell potential, low strength, corrosivity to uncoated steel, and moderate depth of the soil

affect urban development. The potential is low for septic tank filter fields. The slow permeability and depth to rock are the main limitations. Increasing the area of the absorption field helps to overcome these limitations. The potential is medium for recreation uses. The clayey surface layer is the major limitation.

This soil is in capability subclass IIIe and Clay Loam range site.

9—Austin silty clay, 3 to 5 percent slopes. This moderately deep, gently sloping, clayey soil is on uplands. Areas are oblong and range from 10 to 70 acres.

Typically, the surface layer is dark grayish brown, moderately alkaline silty clay about 11 inches thick. Below this to a depth of 22 inches is grayish brown, moderately alkaline silty clay. To a depth of 15 inches the silty clay is grayish brown, and from 15 to 22 inches it is light brownish gray. Between depths of 22 and 30 inches is light gray, moderately alkaline silty clay loam, and below a depth of 30 inches is white, platy chalk. The chalk becomes massive at a depth of about 36 inches.

This soil is well drained. Runoff is medium. Permeability is moderately slow, and available water capacity is low. The hazard of erosion is moderate.

Included with this soil in mapping are small areas of Stephen, Howe, and Whitewright soils. The included soils make up less than 15 percent of any area.

Areas of this Austin soil are used mainly for improved pasture and for cultivated crops. The potential is high for these uses. Improved bermudagrasses are well suited to this soil. Leaving crop residue on the surface of this soil helps to control runoff and erosion. The potential is high for range. Proper stocking and controlled grazing help to maintain a good grass cover and reduce erosion. The potential is medium for wildlife habitat.

This soil has medium potential for most urban uses. The depth of the soil, low strength, corrosivity to uncoated steel, and shrink-swell potential are the main limitations. The potential is low for septic tank filter fields. The slow permeability and depth to rock are the main limitations. The potential is medium for recreation uses. The clayey surface layer is the major limitation.

This soil is in capability subclass IVe and Clay Loam range site.

10—Austin-Urban land complex, 1 to 5 percent slopes. This complex consists of gently sloping soils on ridges. Areas are oval and range from 80 to 200 acres.

This complex is made up of about 55 percent Austin soils, 30 percent Urban land, and 15 percent soils of minor extent. Areas of these soils and Urban land are so intricately mixed that to separate them at the scale used in mapping was not practical.

Typically, the Austin soil has a surface layer of dark grayish brown, moderately alkaline silty clay about 11 inches thick. Below this to a depth of 22 inches is grayish brown, moderately alkaline silty clay. From 11 to 15 inches the silty clay is gray, and from 15 to 22 inches it is light brownish gray. Between depths of 22 to 30 inches is light gray, moderately alkaline silty clay loam. Below a depth of 30 inches is white, platy chalk. The chalk becomes massive at a depth of about 35 inches.

The Austin soil is well drained. Runoff is medium. Permeability is moderately slow, and available water capacity is low. The hazard of erosion is moderate.

Urban land consists mainly of single-unit dwellings and the adjoining streets, driveways, and sidewalks. Service stations and small shopping centers are in some areas.

Included with the Austin soils and Urban land in mapping are small areas of Howe and Whitewright soils.

Areas of this complex are dominantly used for urban development. The potential is medium for this use. The shrink-swell potential, soil depth, and high corrosivity to steel are the major limitations. The potential is medium for recreation development. The clayey surface layer is the major limitation.

This complex is not assigned to a capability subclass or a range site.

11—Bastrop loam, 0 to 1 percent slopes. This deep, nearly level, loamy soil is on high terraces above the flood plains of major streams. Areas are oval and range from 15 to 100 acres.

Typically, the surface layer is yellowish brown, slightly acid loam about 5 inches thick. Below this to a depth of 11 inches is brown, slightly acid loam. From 11 to 24 inches is reddish brown, slightly acid sandy clay loam, and from 24 to 36 inches is yellowish red, medium acid sandy clay loam. Between the depths of 36 and 62 inches is reddish yellow, medium acid sandy clay loam.

This soil is well drained. Surface runoff is medium. Permeability is moderate, and available water capacity is high. The hazard of erosion is slight.

Included with this soil in mapping are small areas of Oklared and Okay soils on the slightly lower parts of terraces. The included soils make up less than 20 percent of any area.

Areas of this Bastrop soil are used mainly for cultivated crops and for pasture. The potential is high for these uses. Improved bermudagrasses are suitable for improved pasture. The potential is medium for range. Proper stocking, controlled grazing, and control of brush are needed in management of range. The potential is high for wildlife habitat.

This soil has high potential for urban development and for recreation development.

This soil is in capability class I and Sandy Loam range site.

12—Bastrop loam, 1 to 3 percent slopes. This deep, gently sloping, loamy soil is on high terraces above flood plains. Areas are oblong and range from 15 to 150 acres.

Typically, the surface layer is reddish brown, neutral loam about 6 inches thick. Below this to a depth of 18 inches is reddish brown, slightly acid clay loam. From 18

to 62 inches is red sandy clay loam that is medium acid in the upper part and slightly acid in the lower part.

This soil is well drained. Surface runoff is medium. Permeability is moderate, and available water capacity is high. The hazard of erosion is slight.

Included with this soil in mapping are small areas of Konsil soils on slightly higher parts of the landscape above terraces and Oklared soils on slightly lower parts of terraces. The included soils make up less than 20 percent of any area.

Areas of this Bastrop soil are used mainly for pasture. The potential is high for this use. Common and coastal bermudagrasses are well suited to improved pasture. The potential is high for row crops and small grain. Leaving crop residue on the surface of this soil helps to control erosion. The potential is medium for range. Proper stocking, controlled grazing, and control of brush are needed in management of range. The potential is high for wildlife habitat.

This soil has high potential for urban development and for recreation development.

This soil is in capability subclass IIe and Sandy Loam range site.

13—Bolar clay loam, 1 to 5 percent slopes. This moderately deep, gently sloping, loamy soil is on uplands. Areas are oval and range from 8 to 60 acres.

Typically, the surface layer of this calcareous, moderately alkaline soil is brown clay loam about 10 inches thick. Below this to a depth of 22 inches is pale brown clay loam. From 22 to 33 inches is very pale brown clay loam that has common soft masses of calcium carbonate, and from 33 to 37 inches is light gray shaly clay that has many yellow mottles and common soft masses and concretions of calcium carbonate. Hard, fractured, limestone is below a depth of 37 inches.

This soil is well drained. Runoff is medium. Permeability is moderate, and available water capacity is low. The hazard of erosion is moderate.

Included with this soil in mapping are small areas of Aledo and Purves soils on low benches and ridges and Sanger soils on the lower parts of slopes and in valley fill areas. The included soils make up less than 20 percent of any area.

Areas of this Bolar soil are used mainly for range, and the potential is high for this use. The potential is low for row crops; however, the yield of small grain on this soil is medium. Terraces and waterways are needed to help protect this soil from erosion. The potential is medium for pasture and for wildlife habitat. Improved bermudagrasses are well suited to this soil.

This soil has medium potential for most urban uses. The depth to rock, low strength, shrink-swell potential, and corrosivity to uncoated steel are the main limitations. The bedrock limits grading and leveling and restricts downward movement of water. The potential is low for septic tank filter fields because of the depth to rock. The potential is medium for recreation uses. The depth to rock and clayey texture of the surface layer are the main limitations.

This soil is in capability subclass IIIe and Clay Loam range site.

14—Bolar clay loam, 5 to 8 percent slopes. This moderately deep, sloping, loamy soil is on uplands. Areas are long and narrow and range from 10 to 70 acres.

Typically, the surface layer of this calcareous, moderately alkaline soil is grayish brown clay loam about 10 inches thick. Below this to a depth of 18 inches is light brownish gray clay loam, and from 18 to 30 inches is light yellowish brown clay loam that has light brownish gray and yellowish brown mottles. Hard fractured limestone is below a depth of 30 inches.

This soil is well drained. Runoff is rapid. Permeability is moderate, and available water capacity is low. The hazard of erosion is severe.

Included with this soil in mapping are small areas of Aledo and Purves soils on low benches and ridges and areas of soils that have a surface layer thinner than that of the Bolar soils. The included soils make up less than 25 percent of any area.

Areas of this Bolar soil are used for range, and the potential is high for this use. Proper stocking and controlled grazing help to obtain good yields. The potential is low for cultivated crops. Terraces and waterways are needed to help protect the soil from erosion. The potential is medium for pasture and for wildlife habitat. Improved bermudagrasses are well suited to this soil.

This soil has medium potential for most urban uses. The depth to rock, low strength, shrink-swell potential, and corrosivity to uncoated steel are the main limitations. The bedrock limits grading and leveling and restricts downward movement of water. The potential is low for septic tank filter fields because of the depth to rock. The potential is medium for most recreation uses. The clayey surface layer and depth to rock are the main limitations.

This soil is in capability subclass IVe and Clay Loam range site.

15—Bolar-Aledo complex, 3 to 12 percent slopes. These gently sloping to strongly sloping soils are on upland ridges and on side slopes along drains. The side slopes are stratified with limestone every 5 to 20 feet at places where there are changes in elevation. Because of this stratification, side slopes have a benched or terraced appearance. Areas are long and narrow and range from 30 to 150 acres.

This complex is made up of about 52 percent Bolar soils and soils that are similar to the Bolar soils, 28 percent Aledo soils, and 20 percent soils of minor extent. These soils are so intricately mixed that to separate them at the scale used in mapping was not practical.

The Bolar soils are in areas between the stratified limestone. They have plane to slightly convex slopes. Typically, the surface layer of these calcareous, moder-

ately alkaline soils is grayish brown clay loam about 9 inches thick. Below this to a depth of 18 inches is light brownish gray clay loam. Between depths of 18 and 26 inches is very pale brown gravelly clay loam. Below a depth of 26 inches is hard fractured limestone.

The Bolar soils are well drained. Surface runoff is rapid, and permeability is moderate. Available water capacity is low. The hazard of erosion is severe if this soil is not protected.

The Aledo soils are on ridgetops and in areas near the bands of limestone. They have convex slopes. Typically, the surface layer is dark grayish brown, moderately alkaline very gravelly clay loam. Hard, slightly fractured limestone is at a depth of about 8 inches. In addition to gravel fragments, the surface layer contains a few fragments of limestone 3 to 10 inches wide.

The Aledo soils are well drained. Surface runoff is rapid. Permeability is moderate, and available water capacity is very low. The hazard of erosion is severe if this soil is not protected.

Included with these soils in mapping are a few small areas of Sanger and Purves soils on the lower parts of the slopes.

Areas of these Bolar and Aledo soils are used for range and for wildlife habitat. The production of native grasses is medium, and the forage is high in quality. Proper stocking and controlled grazing are needed in management of range. The potential is medium for wildlife habitat. These soils are not suited to cultivated crops. The potential is low for improved pasture. Shallow depth and surface stones are limitations for these uses.

These soils have low potential for urban development. Shallow depth to rock is a limitation that is difficult to overcome. The potential is low for recreation development because of slope and rock outcrops.

The soils in this complex are in capability subclass VIs. The Bolar soils are in Clay Loam range site, and the Aledo soils are in Shallow range site.

16—Bunyan and Whitesboro soils, frequently flooded. These nearly level soils are on narrow flood plains of small streams. Slope is 0 to 1 percent. Areas are long and narrow and range from 50 to 600 acres. These soils are flooded one to three times per year for brief periods during spring and fall.

This unit is made up of about 66 percent Bunyan soils and soils that are similar to Bunyan soils, 30 percent Whitesboro soils, and 4 percent soils of minor extent. The extent of these soils in mapped areas is not uniform, and the pattern in which the soils occur is not regular.

Typically, the Bunyan soil has a surface layer of light yellowish brown, neutral fine sandy loam about 22 inches thick. Below this to a depth of 48 inches is slightly acid clay loam. To a depth of 30 inches the clay loam is yellowish brown, and from 30 to 48 inches it is dark yellowish brown and has a few light brown mottles. Between depths of 48 and 65 inches is yellowish brown, neutral loam.

The Bunyan soil is well drained. Runoff is slow. Permeability is moderate, and available water capacity is high. The hazard of erosion is slight.

Typically, the Whitesboro soil has a surface layer of dark grayish brown, neutral loam about 19 inches thick. Below this to a depth of 27 inches is dark grayish brown, slightly acid sandy clay loam that has gray and reddish brown mottles. From 27 to 39 inches is brown, slightly acid clay loam that has reddish brown and gray mottles. Between depths of 39 and 72 inches is mottled gray and reddish yellow, moderately alkaline sandy clay loam.

This Whitesboro soil is moderately well drained. Runoff is slow. Permeability is moderate, and available water capacity is high. The hazard of erosion is slight.

Included with these soils in mapping are small areas of soils that have a coarser texture than the Bunyan and Whitesboro soils. The included soils make up less than 20 percent of any area.

Areas of these soils are used for pasture, and the potential is high for this use. Improved bermudagrasses are suited to these soils. These soils are not suited to cultivated crops. The potential is high for range and for wildlife habitat. Deferred grazing and control of brush are needed in management of range.

These soils have low potential for urban uses and for recreation uses. The flooding and wetness are the main limitations.

These soils are in capability subclass Vw and Loamy Bottomland range site.

17—Callisburg fine sandy loam, 1 to 3 percent slopes. This deep, loamy, gently sloping soil is on foot slopes and in valley fill areas on uplands. Areas are oblong and range from 7 to about 130 acres.

Typically, the surface layer is brown, slightly acid fine sandy loam about 6 inches thick. Below this to a depth of 16 inches is strong brown, medium acid sandy clay loam. From 16 to 24 inches is brownish yellow, medium acid sandy clay that has a few reddish brown mottles; from 24 to 47 inches is yellowish brown, very strongly acid sandy clay that has light gray and red mottles; and between depths of 47 and 60 inches is yellowish brown, medium acid sandy clay that has light brownish gray and red mottles.

This soil is well drained. Runoff is slow. Permeability is moderately slow, and available water capacity is high. The hazard of erosion is slight.

Included with this soil in mapping are small areas of Gasil and Konsil soils on low ridges. The included soils make up less than 20 percent of any area.

Areas of this soil are used mainly for pasture and for range. The potential is medium for these uses. Pasture is mainly improved bermudagrasses. Proper stocking, controlled grazing, and control of brush are needed in management of range. The potential is medium for cultivated crops. Returning crop residue to the surface of this soil helps to reduce erosion and maintain the content of organic matter. Terraces and farming on the contour

help to control erosion on cropland. The potential is high for wildlife habitat.

This soil has medium potential for urban uses. The low strength is the main limitation. This can be overcome by good design and proper installation of structures. The potential is high for most recreation uses.

This soil is in capability subclass IIe and Sandy Loam range site.

18—Callisburg fine sandy loam, 2 to 5 percent slopes, eroded. This deep, loamy, gently sloping soil is on low ridges. Areas are oblong and range from 10 to about 160 acres. This soil has a series of rills and U-shaped gullies that are 60 to 160 feet apart, 6 to 14 inches deep, and 3 to 20 feet wide. The rills and gullies have sloping sides and are easily crossed by farm machinery.

Typically, the surface layer is pale brown, neutral fine sandy loam about 5 inches thick. Below this to a depth of 16 inches is brown, slightly acid sandy clay. From 16 to 27 inches is yellowish brown, medium acid sandy clay that has red and reddish brown mottles, and from 27 to 50 inches is brownish yellow, medium acid sandy clay that has red and light gray mottles. Between depths of 50 and 62 inches is brownish yellow, neutral sandy clay that has strong brown mottles.

This soil is well drained. Surface runoff is medium. Permeability is moderately slow, and available water capacity is high. The hazard of erosion is moderate.

Included with this soil in mapping are small areas of Gasil and Konsil soils on the higher parts of the landscape and small areas of Crosstell soils on the lower parts. The included soils make up less than 20 percent of any area.

Areas of this soil are used for pasture and for range. The potential is medium for these uses. Proper stocking, deferred grazing, and control of brush are needed in management of range. The potential is medium for cultivated crops. Terraces and farming on the contour are needed to help control erosion on cropland. The potential for wildlife habitat is high.

This soil has medium potential for most urban uses. The low strength is the main limitation, and this can be overcome by good design of structures. The potential for most recreation development is high.

This soil is in capability subclass IIIe and Sandy Loam range site.

19—Callisburg fine sandy loam, 5 to 8 percent slopes. This deep, sloping, loamy soil is on low ridges. Areas are mainly oval and range from 10 to 160 acres.

Typically, the surface layer is brown, medium acid fine sandy loam about 6 inches thick. Below this to a depth of 14 inches is brown, medium acid sandy clay loam. Between depths of 14 and 70 inches is medium acid sandy clay. From 14 to 30 inches the clay is brownish yellow and has red mottles, from 30 to 44 inches it is reddish yellow and has red mottles, and from 44 to 70 inches it is reddish yellow and has red and gray mottles.

This soil is well drained. Surface runoff is medium. Permeability is moderately slow, and available water capacity is high. The hazard of erosion is severe.

Included with this soil in mapping are small areas of Gasil and Konsil soils. The included soils make up about 15 percent of most areas.

Areas of this soil are used for pasture and for range. The potential is medium for these uses. Improved bermudagrasses are suited to this soil. Maintaining a good stand of grass is necessary to control erosion. Proper stocking and controlled grazing help to maintain a good cover of grass. The potential is low for cultivated crops. Terraces are needed to help control erosion. The potential is high for wildlife habitat.

This soil has medium potential for urban uses. The low strength is a major limitation, and erosion is a hazard. Diversions, terraces, or other measures are needed to help protect this soil from erosion during construction. The potential is medium for recreation uses. Slope is the main limitation.

This soil is in capability subclass IVe and Sandy Loam range site.

20—Callisburg soils, 3 to 8 percent slopes, severely eroded. These deep, gently sloping to sloping, loamy soils are on severely eroded ridges and side slopes along streams. Areas are irregular in shape and range from 10 to 60 acres. These soils have a series of gullies that are 30 to 120 feet apart, 1 to 5 feet deep, and 6 to 35 feet wide. Most of the gullies can not be crossed by farm machinery.

Typically, the surface layer of a Callisburg soil is brown, neutral fine sandy loam about 3 inches thick. Below this to a depth of 12 inches is light yellowish brown, medium acid sandy clay that has reddish yellow mottles, and from 12 to 30 inches is brownish yellow, strongly acid sandy clay that has reddish yellow mottles. Between depths of 30 and 52 inches is light yellowish brown, strongly acid clay that has reddish yellow and light gray mottles.

These soils are well drained. Surface runoff is rapid. Permeability is moderately slow, and available water capacity is high. The hazard of erosion is severe.

Included with these soils in mapping are eroded areas of Aubrey, Gasil, and Konsil soils that are mainly on the higher parts of the landscape or the upper parts of slopes. The included soils make up less than 35 percent of any area.

Areas of these soils are used for native pasture. Sparse stands of common bermudagrass, threeawn, and silver bluestem are the main grasses. The potential is medium for range. Controlled grazing and control of brush are needed in management of range. The potential is low for pasture; however, the production of common and improved bermudagrasses is moderate in some areas. Maintaining a good vigorous stand of grasses is vital to control erosion. These soils are not suitable for cultivated crops. The potential is high for wildlife habitat.

These soils have low potential for most urban uses. The low strength is a major limitation, and erosion is a hazard. Terraces, diversions, or other measures are needed during construction to help protect these soils from erosion. The potential is low for recreation uses. Shaping and smoothing of the surface is required before the installation of recreation areas.

These soils are in capability subclass VIe and Sandy Loam range site.

21—Crockett loam, 0 to 1 percent slopes. This deep, nearly level, loamy soil is on smooth uplands and in valley fill areas. Areas are oval and range from 6 to 100 acres.

Typically, the surface layer is dark grayish brown, slightly acid loam about 9 inches thick. Below this to a depth of 40 inches is medium acid and slightly acid clay. From 9 to 16 inches the clay is mottled dark grayish brown and reddish brown; between 16 and 28 inches it is pale brown and has brownish yellow mottles; and from 28 to 40 inches it is grayish brown. Between depths of 40 and 53 inches is dark grayish brown, neutral clay, and below this to a depth of 60 inches is dark grayish brown, mildly alkaline shaly clay.

This soil is moderately well drained. Runoff is slow. Permeability is very slow, and available water capacity is high. The hazard of erosion is slight.

Included with this soil in mapping are small areas of Normangee soils on slightly higher parts of the landscape and Wilson and Mabank soils on slightly lower parts. The included soils make up less than 25 percent of any area.

Areas of this soil are used for cultivated crops and for pasture. Small grain is the main crop. Common and improved bermudagrasses are the major pasture grasses. Mesquite trees invade abandoned fields and poorly managed areas. The potential is high for pasture and is medium for cultivated crops. Returning crop residue to the surface of this soil helps to improve tilth and conserve moisture. The potential is medium for range and for wildlife habitat. Proper stocking, control of brush, and controlled grazing are the main needs in management of range.

This soil has medium potential for most urban uses. The corrosivity to uncoated steel, shrink-swell potential, and low strength are the main limitations. These can be overcome by proper design and careful installation of structures. The potential for septic tank filter fields is low because of the very slow permeability. The potential is medium for recreation development. The very slow permeability is the main limitation. Adequate drainage needs to be provided for recreation sites.

This soil is in capability subclass IIIs and Claypan Prairie range site.

22—Crockett loam, 1 to 3 percent slopes. This deep, gently sloping, loamy soil is on smooth uplands and in valley fill areas. Areas are oblong or irregular in shape. They range from about 10 to 90 acres.

Typically, the surface layer is slightly acid, brown loam about 6 inches thick. Below this to a depth of 14 inches is light yellowish brown, medium acid clay that has light reddish brown mottles. From 14 to 29 inches is light brownish gray, neutral clay that has yellowish red mottles, and from 29 to 40 inches is light brownish gray, moderately alkaline clay that has brownish yellow mottles and a few calcium carbonate concretions. Between depths of 40 and 52 inches is light gray, moderately alkaline clay that has yellow mottles, and below this to a depth of 80 inches is brownish yellow and gray, moderately alkaline shaly clay.

This soil is moderately well drained. Runoff is slow. Permeability is very slow, and available water capacity is high. The hazard of erosion is moderate.

Included with this soil in mapping are small areas of Callisburg, Normangee, and Mabank soils. The included soils make up less than 25 percent of any area.

Areas of this soil are used mainly for pasture. The potential is high for this use. Common and improved bermudagrasses are the major pasture grasses. The potential is medium for cultivated crops. Returning crop residue to the surface of this soil helps conserve moisture and reduce erosion. Cover crops are beneficial on this soil. Farming on the contour and terracing are needed to help reduce erosion. The potential is medium for range and for wildlife habitat. Proper stocking and controlled grazing are needed in management of range.

This soil has medium potential for urban development. The high shrink-swell potential, corrosivity to uncoated steel, and low strength are the main limitations. Proper design and installation of structures is needed. The potential is low for septic tank filter fields because movement of water in the clayey subsoil is very slow. The potential is medium for recreation uses. The very slow permeability is a major limitation. This limitation can be overcome by installing drainage and by paving areas.

This soil is in capability subclass IIIe and Claypan Prairie range site.

23—Crockett loam, 2 to 5 percent slopes, eroded. This deep, gently sloping, loamy soil is on convex ridges and side slopes on uplands. Areas are irregular in shape and range from 10 to 150 acres. Most areas of this soil have shallow gullies that are 20 to 120 feet apart. Many of the gullies are partially healed and covered with grass. In many areas the surface layer is not eroded between the gullies, but in some areas it has been removed or partly removed by sheet erosion.

Typically, the surface layer is dark grayish brown, medium acid loam about 4 inches thick. Below this to a depth of 11 inches is mottled reddish brown and dark grayish brown, slightly acid clay. From 11 to 23 inches is light olive brown, slightly acid clay that has light yellowish brown mottles, and from 23 to 44 inches is light olive brown clay that is neutral in the upper part and mildly alkaline in the lower part. Between depths of 44 and 52 inches is light olive brown, moderately alkaline clay that

has yellowish brown mottles, and below this to a depth of 65 inches is mottled yellowish brown, light brownish gray, and light olive brown, moderately alkaline clay.

This soil is moderately well drained. Runoff is medium. Permeability is very slow, and available water capacity is high. The hazard of erosion is severe.

Included with this soil in mapping are small areas of Crosstell soils on the same positions in the landscape as the Crockett soil and small areas of Callisburg soils on higher positions. The included soils make up less than 20 percent of any area.

Areas of this soil are used mainly for pasture. The potential is medium for this use. Common and improved bermudagrasses are the main pasture grasses. Proper fertilization and keeping a good cover of grass on the soil help to improve pasture. The potential is medium for cultivated crops. Terraces are needed to help control runoff and reduce erosion. Returning crop residue to the surface of this soil helps to control erosion and conserve moisture. The potential is medium for range and for wildlife habitat. Control of the invading mesquite trees and controlled grazing are needed in management of range.

This soil has medium potential for most urban uses. Erosion is a hazard, and the shrink-swell potential and low strength are limitations. These can be overcome by good design and careful installation of structures. The potential is low for septic tank filter fields because of the very slow permeability. The potential is medium for recreation uses. The very slow permeability is the main limitation. Adequate drainage needs to be provided for recreation uses.

This soil is in capability subclass IVe and Claypan Prairie range site.

24—Crockett-Urban land complex, 0 to 3 percent slopes. These nearly level and gently sloping soils are in valley fill areas and in low parts of the landscape. Areas are oval and average about 70 acres.

This complex is made up of about 45 to 70 percent Crockett soils, 20 to 40 percent Urban land, and 25 percent or less soils of minor extent. Areas of the soils and Urban land are so intricately mixed that to separate them at the scale used in mapping was not practical.

Typically, the surface layer of a Crockett soil is dark grayish brown, medium acid loam about 4 inches thick. Below this, the soil is clay to a depth of 65 inches; to a depth of 11 inches, it is mottled reddish brown and dark grayish brown and is slightly acid; from 11 to 23 inches it is light olive brown and slightly acid and has mottles of light yellowish brown; and from 23 to 44 inches it is light olive brown and is slightly acid in the upper part and mildly akaline in the lower part. Between depths of 44 and 52 inches the clay is light olive brown and moderately alkaline and has mottles of yellowish brown, and from 52 to 65 inches it is yellowish brown, light brownish gray, and light olive brown and is moderately alkaline.

The Crockett soils are moderately well drained. Permeability is very slow, and available water capacity is high. These soils receive runoff from soils in higher positions on the landscape. Because of the very slow permeability, irrigation water needs to be applied at a slow rate. The dense clayey subsoil should be considered when selecting plants to be grown in this soil.

Urban land consists mainly of homesites and the adjoining streets, sidewalks, driveways, and patios. There are some commercial buildings, schools, and churches. Some areas have been filled with loamy material.

Included with these soils in mapping are the Callisburg, Mabank, and Normangee soils.

The soils in this Crockett-Urban land complex have medium potential for urban development. The high shrink-swell potential, low strength, corrosivity to uncoated steel, and very slow permeability are the main limitations. Proper design and installation of structures is essential.

This complex is not assigned to a capability subclass or range site.

25—Crosstell fine sandy loam, 1 to 3 percent slopes. This deep, gently sloping, loamy soil is on broad ridges on uplands. Areas are oval and range from 10 to 200 acres.

Typically, the surface layer is dark yellowish brown, slightly acid fine sandy loam about 8 inches thick. Below this to a depth of 36 inches is slightly acid clay. From 8 to 21 inches the clay is reddish brown and has yellowish red mottles, and from 21 to 36 inches it is red and has brownish yellow mottles. Between depths of 36 and 54 inches is mottled brownish yellow, dark yellowish brown, and grayish brown, yellowish brown, and light brownish gray shaly clay.

This soil is moderately well drained. Runoff is rapid. Permeability is very slow, and available water capacity is medium. The hazard of erosion is moderate.

Included with this soil in mapping are small areas of Callisburg and Aubrey soils. The included soils make up less than 20 percent of any area.

Most areas of these soils are used for cultivated crops and for pasture. The potential is medium for these uses. Returning crop residue to the surface of this soil helps to control erosion and conserve moisture. Improved bermudagrasses are fairly well suited to this soil. The potential is low for range. Controlled grazing and control of brush are needed in management of range. The potential is medium for wildlife habitat.

This soil has medium potential for most urban uses. The shrink-swell potential, corrosivity to uncoated steel, and low strength are the major limitations. Good design and careful installation of structures is needed to overcome these limitations. The potential is low for septic tank filter fields because of the very slow permeability. The potential is medium for most recreation uses. Very slow permeability is the major limitation.

This soil is in capability subclass IIIe and Tight Sandy Loam range site.

26—Crosstell fine sandy loam, 2 to 5 percent slopes, eroded. This deep, gently sloping, loamy soil is on convex ridges. Areas are oval or are irregular in shape. They range from 10 to 350 acres. This soil has shallow gullies and rills that are 20 to 200 feet apart and are crossable by farm machinery. The clayey lower part of this soil has been exposed in the rills and gullies, and part of the surface layer in areas between the rills and gullies has been removed by sheet erosion.

Typically, the surface layer is pale brown, neutral fine sandy loam about 3 inches thick. Below this to a depth of 22 inches is very strongly acid clay. From 3 to 11 inches the clay is red and has reddish yellow and yellowish red mottles, and from 11 to 22 inches it is reddish yellow and has red mottles. Between depths of 22 and 43 inches is mottled brownish yellow, red, and light gray, strongly acid clay. Below this to a depth of 60 inches is mottled yellowish brown, light gray, and reddish brown, mildly alkaline shaly clay.

This soil is moderately well drained. Runoff is medium. Permeability is very slow, and available water capacity is medium. The hazard of erosion is severe.

Included with this soil in mapping are small areas of Callisburg and Aubrey soils. The included soils make up less than 25 percent of any area.

Most areas of these soils are used for pasture and for cultivated crops. The potential is low for cultivated crops. Terraces help to control runoff and reduce erosion. Returning crop residue to the surface of this soil helps to control erosion and conserve moisture. The potential is medium for pasture. Improved bermudagrasses are fairly well suited to this soil. The potential is low for range. Controlled grazing and control of brush are needed in management of range. The potential is medium for wildlife habitat.

This soil has medium potential for most urban uses. Erosion is a hazard, and the shrink-swell potential and low strength are major limitations. These limitations can be overcome by good design and careful installation of structures. The potential is low for septic tank filter fields because of the very slow permeability. The potential is medium for most recreation uses. The very slow permeability is the major limitation.

This soil is in capability subclass IVe and Tight Sandy Loam range site.

27—Crosstell-Urban land complex, 1 to 5 percent slopes. This complex consists of gently sloping soils on uplands. Areas are oblong or oval and range from 15 to 60 acres.

This complex is made up of about 45 to 65 percent Crosstell soils, 30 to 50 percent Urban land, and less than 25 percent soils of minor extent. Areas of these soils and Urban land are so intricately mixed that to separate them at the scale used in mapping was not practical.

Typically, the Crosstell soil has a surface layer of pale brown, neutral fine sandy loam about 3 inches thick. Below this to a depth of 22 inches is very strongly acid clay. From 3 to 11 inches the clay is red and has reddish yellow and yellowish red mottles, and from 11 to 22 inches it is reddish yellow and has red mottles. Between depths of 22 and 43 inches is mottled brownish yellow, red, and light gray, strongly acid clay, and below that to a depth of 60 inches is mottled yellowish brown, light gray, and reddish brown, mildly alkaline shaly clay.

The Crosstell soils are moderately well drained. Runoff is medium. Permeability is very slow, and available water capacity is medium. The hazard of erosion is severe.

Urban land consists mainly of single unit dwellings and the adjoining streets, sidewalks, driveways, and patios. Included in areas are commercial buildings, schools, and churches.

Included with these Crosstell soils and Urban land in mapping are small areas of Aubrey and Callisburg soils.

The soils in this complex have medium potential for urban development. The high shrink-swell potential, low strength, and very slow permeability are main limitations. To overcome these limitations, proper design and installation of structures is essential.

This complex is not assigned to a capability subclass or a range site.

28—Eddy gravelly clay loam, 5 to 12 percent slopes. This very shallow to shallow, sloping to strongly sloping, loamy soil is on side slopes of ridges. Areas are long and narrow to oval and range from 10 to 50 acres.

Typically, the surface layer is light brownish gray, moderately alkaline gravelly clay loam about 5 inches thick. Below this to a depth of 13 inches is light brownish gray, moderately alkaline very gravelly clay loam that has about 65 percent platy chalk fragments. Below a depth of 13 inches is platy, white chalk. The chalk is massive at a depth of about 16 inches.

This soil is well drained. Surface runoff is rapid. Permeability is moderately slow, and available water capacity is very low. The hazard of erosion is severe.

Included with this soil in mapping are small areas of Whitewright soils. The included soils make up less than 15 percent of any area.

Most areas of this soil are used for range. The potential is low for this use. Stunted oak trees are in most areas. Proper grazing and control of brush are needed in management of range. The potential is low for pasture. King Ranch bluestem is fairly well suited to this soil. Proper fertilization and controlled grazing are needed in management of pasture. This soil is not suitable for cultivated crops. The potential is low for wildlife habitat.

This soil has medium potential for urban uses. The shallow depth to rock is a limitation, but the rock is soft and rippable and makes a good footing for foundations. The potential is low for septic tank filter fields because of the shallow depth to rock. The potential is medium for recreation uses. The shallow depth to rock and small stones on the surface are limitations.

This soil is in capability subclass VIe and Chalky Ridge range site.

29—Elbon clay, occasionally flooded. This deep, nearly level, clayey soil is on flood plains of major streams. Areas are long and narrow and range from 20 to several hundred acres. This soil is subject to flooding for short periods about once every 3 to 5 years.

Typically, the surface layer of this moderately alkaline soil is dark grayish brown clay about 12 inches thick. Below this to a depth of 23 inches is grayish brown clay. Between depths of 23 and 43 inches is light brownish gray clay, and below this to a depth of 65 inches is gray clay.

This soil is moderately well drained. Runoff is slow. Permeability is moderately slow, and available water capacity is high. The hazard of erosion is slight.

Included with this soil in mapping are small areas of Trinity and Whitesboro soils on slightly lower parts of the landscape. Also included are small areas of Elbon soils on narrow flood plains that are flooded one or more times in a period of 2 years. The included soils make up less than 25 percent of any area.

Areas of this soil are used mainly for cultivated crops and pasture. Some small uncleared areas that are subject to frequent flooding are used for wildlife habitat. Elm and pecan are the main trees in the uncleared areas. The potential is high for cultivated crops. Returning crop residue to the surface of this soil helps to maintain tilth. The use of cover crops and grasses and legumes in the cropping system is beneficial. The potential is high for pasture and for range. Good yields of bermudagrasses are common on this soil. Proper stocking and deferred grazing are needed in management of range. The potential is medium for wildlife habitat.

This soil has low potential for most urban uses. Flooding is a hazard, and the shrink-swell potential and low strength are the main limitations. The brief occasional floods are damaging to urban structures, septic tank filter fields, and sewage lagoons. This hazard is difficult to overcome. The potential is low for recreation development. The flooding is a hazard for camp areas. The clayey texture is the main limitation for picnic areas and playgrounds, but can be overcome by using loamy fill and maintaining a good grass cover.

This soil is in capability subclass IIIw and Clayey Bottomland range site.

30—Elbon soils, frequently flooded. These deep, nearly level soils are on flood plains of major streams. Areas are oblong and range from 20 to about 2,000 acres. In most years, these soils are subject to flooding one or more times during spring and fall (fig. 2). Thin layers of recently deposited sediments of various textures are common on the surface of these soils.

Figure 2.—Flooding in area of Elbon soils, frequently flooded.

Typically, the surface layer of an Elbon soil is moderately alkaline, dark grayish brown clay about 12 inches thick. Below this to a depth of 20 inches is dark grayish brown silty clay. Between depths of 20 and 53 inches is light brownish gray silty clay loam, and below this to a depth of 72 inches is grayish brown clay.

These soils are moderately well drained. Runoff is very slow. Permeability is moderately slow, and available water capacity is high. The hazard of erosion is slight.

Included with these soils in mapping are small areas of Trinity soils. The included soils make up less than 30 percent of any area.

Areas of these soils are used for pasture and for wildlife habitat. The potential is high for pasture and is medium for wildlife habitat. Common and improved bermudagrasses are well suited to these soils (fig. 3).

The potential is high for range. Proper stocking, controlled grazing, and control of brush are needed in management of range. These soils are not suitable for cultivated crops because of the flooding (fig. 4).

Figure 3.—Bermudagrass pasture and damaged fence on Elbon soils, frequently flooded, after a heavy rain.

Figure 4.—Irrigation equipment damaged by flooding. Pasture is coastal bermudagrass on Elbon soils, frequently flooded.

These soils have low potential for urban uses because of the flooding, wetness, and high shrink-swell potential. These are difficult to overcome.

The potential for recreation uses is low. The wetness and clayey texture are the main limitations, and flooding is a hazard.

These soils are in capability subclass Vw and Clayey Bottomland range site.

31—Fairlie-Urban land complex, 1 to 5 percent slopes. This complex consists of gently sloping soils on side slopes above drains. Areas are oval and range from 20 to 90 acres.

This complex is made up of 40 to 70 percent Fairlie soils, 20 to 50 percent Urban land, and 25 percent or less soils of minor extent. Areas of these soils and Urban land are so intricately mixed that to separate them at the scale used in mapping was not practical.

Typically, the surface layer of a Fairlie soil is moderately alkaline, very dark gray clay about 15 inches thick. Below this to a depth of 28 inches is moderately alkaline, dark grayish brown clay. From 28 to 46 inches is moderately alkaline, grayish brown clay that has light olive brown mottles, and below a depth of 46 inches is white chalk.

The Fairlie soils are moderately well drained. Runoff is medium. Permeability is very slow, and available water capacity is medium. The hazard of erosion is slight.

Urban land consists mainly of single unit dwellings and the adjoining streets, sidewalks, and patios. Included in some areas are commercial buildings and shopping centers.

The soils in this complex have low potential for urban development. The shrink-swell potential, low strength, and corrosivity to uncoated steel are the main limitations. Good design and careful installation of structures is needed to overcome these limitations. The moderately alkaline, heavy clay needs to be considered when selecting plants for this soil.

This complex is not assigned to a capability subclass or a range site.

32—Fairlie and Houston Black clays, 0 to 1 percent slopes. These deep, nearly level, clayey soils are on broad uplands. Areas are irregular in shape and range from 30 to 600 acres.

This map unit has an average composition of 64 percent Fairlie soils, but ranges from 40 to 80 percent; 30 percent Houston Black soils, but ranges from 10 to 40 percent; and 6 percent soils of minor extent. The extent of these soils in mapped areas is not uniform, and the pattern in which they occur is not regular.

Typically, the Fairlie soil has a surface layer of very dark gray, moderately alkaline clay about 7 inches thick. Below this to a depth of 46 inches is black, moderately alkaline clay that has a few very dark grayish brown mottles below a depth of 22 inches. Below a depth of 46 inches is white chalk (fig. 5).

Figure 5.—Profile of Fairlie clay. Chalk is at a depth of 48 inches.

The Fairlie soil is moderately well drained. Runoff is medium. Permeability is very slow, and available water capacity is medium. The hazard of erosion is slight.

Typically, the Houston Black soil has a surface layer of dark gray, moderately alkaline clay about 13 inches thick. Below this to a depth of 79 inches is moderately alkaline clay. From 13 to 53 inches the clay is gray, and from 53 to 79 inches it is dark grayish brown and has yellowish brown mottles. Below a depth of 79 inches is white chalk.

The Houston Black soil is moderately well drained. Runoff is slow. Permeability is very slow, and available water capacity is high. The hazard of erosion is slight.

Included with these soils in mapping are small areas of Austin soils on low ridges and along the edges of areas. The included soils make up less than 15 percent of any area.

Most areas of these soils are used for crops, and the potential is high for this use. Returning crop residue to the surface of these soils helps to improve tilth and conserve moisture. The potential is high for pasture. Improved bermudagrasses are well suited to these soils. The potential is high for range and for wildlife habitat. Proper stocking and controlled grazing are needed in management of range.

These soils have low potential for most urban uses. The high shrink-swell potential is the main limitation. Good design and careful installation of structures is needed on these soils to minimize the effects of shifting and cracking. The potential is low for most recreation uses. The clayey surface layer and very slow permeability are the main limitations.

These soils are in capability subclass IIw and Blackland range site.

33—Fairlie and Houston Black clays, 1 to 3 percent slopes. These deep, gently sloping, clayey soils are on broad uplands. Areas are irregular in shape and range from 30 to more than 1,000 acres.

This map unit has an average composition of 58 percent Fairlie soils, 36 percent Houston Black soils, and 6 percent soils of minor extent. The extent of these soils in mapped areas is not uniform, and the pattern in which the soils occur is not regular.

Typically, the Fairlie soil has a surface layer of very dark gray, moderately alkaline clay about 15 inches thick. Below this to a depth of 46 inches is moderately alkaline clay. From 15 to 28 inches the clay is dark grayish brown, and from 28 to 46 inches it is grayish brown and has light olive brown mottles. Below a depth of 46 inches is white chalk.

The Fairlie soil is moderately well drained. Runoff is medium. Permeability is very slow, and available water capacity is medium. The hazard of erosion is slight.

Typically, the Houston Black soil has a surface layer of very dark gray, moderately alkaline clay about 17 inches thick. Below this to a depth of 65 inches is moderately alkaline clay. From 17 to 26 inches the clay is dark grayish brown, from 26 to 41 inches it is grayish brown and has olive brown mottles, and from 41 to 65 inches it is light olive brown and has olive yellow mottles.

The Houston Black soil is moderately well drained. Runoff is medium. Permeability is very slow, and available water capacity is high. The hazard of erosion is slight.

Included with these soils in mapping are small areas of Austin soils on low ridges. The included soils make up less than 15 percent of any area.

Most areas of these soils are used for cultivated crops. The potential is high for this use. Leaving crop residue on the surface of these soils helps to conserve moisture and improve tilth. The potential is high for pasture. Common and improved bermudagrasses are well suited to these soils. The potential is high for range and for wildlife habitat. Proper stocking and controlled grazing are needed in the management of range.

The potential is low for most urban uses. The shrink-swell potential is the main limitation. Good design and careful installation of structures is needed on these soils to minimize the affects of shifting and cracking (fig. 6). The potential is low for most recreational uses. The clayey texture and very slow permeability are the main limitations.

These soils are in capability subclass IIe and Blackland range site.

34—Gasil loamy fine sand, 1 to 5 percent slopes. This deep, gently sloping, sandy soil is on side slopes of small ridges. Areas are oval and range from 10 to 160 acres.

Typically, the surface layer is brown and yellowish brown, medium acid to slightly acid loamy fine sand about 10 inches thick. Below this to a depth of 66 inches is sandy clay loam. From 10 to 22 inches the sandy clay loam is strong brown and medium acid, and from 22 to 33 inches it is brownish yellow and strongly acid. From 33 to 45 inches the sandy clay loam is reddish yellow and strongly acid and has yellowish red mottles, from 45 to 56 inches it is brownish yellow and strongly acid and has red mottles, and from 56 to 66 inches it is reddish yellow and strongly acid and has red mottles.

Figure 6.—Damage to highway embankment because of soil slippage in an area of Fairlie and Houston Black clays, 1 to 3 percent slopes.

This soil is well drained. Runoff is slow. Permeability is moderate, and available water capacity is medium. The hazard of erosion is severe on bare slopes. The soil is subject to blowing if left unprotected.

Included with this soil in mapping are small areas of Konsil soils on slightly higher ridges and Callisburg soils mainly on lower parts of the landscape. The included soils make up less than 15 percent of any area.

Areas of this soil are used mainly for pasture, and the potential is medium for this use. The potential is medium for cultivated crops (fig. 7). Leaving crop residue on the surface of this soil helps to conserve moisture and maintain the content of organic matter. Terraces, farming on the contour, and cover crops are needed to reduce erosion. The potential is medium for range. Proper stocking and controlled grazing are needed in management of range. The potential is high for wildlife habitat.

This soil has high potential for most urban uses. The main limitation is low strength, but this can be overcome by proper design of structures. The potential is medium for recreation development. The sandy surface layer is the main limitation. An adequate cover of grass is needed to help prevent soil blowing.

Figure 7.—Peanuts ready for threshing on Gasil loamy fine sand, 1 to 5 percent slopes.

This soil is in capability subclass IIIe and Sandy Loam range site.

35—Gasil loamy fine sand, 5 to 8 percent slopes. This deep, sloping, sandy soil is on side slopes of convex ridges. Areas are oblong and range from 20 to 80 acres.

Typically, the surface layer is yellowish brown, neutral loamy fine sand about 10 inches thick. Below this to a depth of 63 inches is sandy clay loam. From 10 to 32 inches the sandy clay loam is brownish yellow and slightly acid, from 32 to 55 inches it is yellow and medium acid and has red mottles, and from 55 to 63 inches it is yellow and medium acid and has red and strong brown mottles.

This soil is well drained. Runoff is slow. Permeability is moderate, and available water capacity is medium. The hazard of erosion is moderate. This soil is subject to blowing if left unprotected.

Included with this soil in mapping are small areas of Callisburg and Konsil soils. The included soils make up less than 20 percent of any area.

Areas of this soil are used mainly for pasture. The potential is medium for this use. Common and improved bermudagrasses are well suited to this soil. Some areas have a native stand of post oak and an understory of greenbriar and range grasses. The potential is low for cultivated crops. Erosion is the main hazard. Terracing and farming on the contour are needed to reduce soil loss. Returning crop residue to the surface of this soil and including cover crops in the cropping system help to maintain moisture and to slow runoff. The potential is medium for range. Proper stocking and controlled grazing are needed in management of range. The potential is high for wildlife habitat.

This soil has high potential for most urban uses. Low strength is the main limitation, but this can be overcome by proper design of structures. The potential is medium for recreation development. The sandy surface layer is the major limitation. An adequate cover of grass is needed to help keep this soil from blowing. Slope is a limitation for playgrounds.

This soil is in capability subclass IVe and Sandy Loam range site.

36—Gasil-Urban land complex, 1 to 8 percent slopes. This complex consists of gently sloping to sloping soils on convex ridges and side slopes. Areas are oblong and range from 20 to 250 acres.

This complex is made up of about 40 to 70 percent Gasil soils, 20 to 40 percent Urban land, and less than 25 percent soils of minor extent. The Gasil soils and Urban land are so intricately mixed that to separate them at the scale used in mapping was not practical.

Typically, the surface layer of a Gasil soil is brown, medium acid loamy fine sand about 5 inches thick. Below this to a depth of 10 inches is yellowish brown, slightly acid loamy fine sand. Next to a depth of 66 inches is sandy clay loam. From 10 to 22 inches the sandy clay loam is strong brown and medium acid, and from 22 to 33 inches it is brownish yellow and strongly acid. From 33 to 45 inches the sandy clay loam is reddish yellow and strongly acid and has yellowish red mottles, from 45 to 56 inches it is brownish yellow and strongly acid and has yellowish red mottles, and from 56 to 66 inches it is reddish yellow and strongly acid and has red mottles.

The Gasil soil is well drained. Runoff is slow. Permeability is moderate, and available water capacity is medium. The hazard of erosion is moderate.

Urban land consists of single unit dwellings and the adjoining streets, sidewalks, and driveways. Also in some areas are small commercial buildings, shopping centers, and paved parking lots. Some areas have cuts and fills or other changes that so obscure the original soils that their identification and classification are not practical.

Included with these Gasil soils and Urban land in mapping are mainly areas of Callisburg and Konsil soils.

The soils in this complex have high potential for urban uses. The low strength is the main limitation, but this can be overcome by good design of structures and roads. Areas left bare during construction should be protected from erosion by the use of terraces or diversions. A wide variety of plants are suited to the soils in this complex, and lawns and trees are easily established.

This complex is not assigned to a capability subclass or a range site.

37—Gasil soils, 2 to 5 percent slopes, eroded. These deep, gently sloping, sandy and loamy soils are on convex ridges. Areas are oblong and range from 10 to 100 acres. These soils have U-shaped rills and gullies, 50 to 200 feet apart, that are 5 to 30 feet wide and 6 inches to 2 feet deep. In areas where the original surface layer has been mixed with material from the subsoil, the texture of the surface layer is variable and ranges from loamy fine sand to fine sandy loam.

Typically, the surface layer of a Gasil soil is pale brown, slightly acid loamy fine sand about 5 inches thick. Below this to a depth of 63 inches is medium acid sandy clay loam. From 5 to 41 inches the sandy clay loam is brownish yellow, and has dark red mottles in the lower part, and from 41 to 63 inches it is yellow and has red mottles.

These soils are well drained. Runoff is medium. Permeability is moderate, and available water capacity is medium. The hazard of erosion is severe on bare slopes.

Included with these soils in mapping are small areas of Callisburg and Konsil soils. The included soils make up less than 20 percent of any area.

Areas of these soils are used for pasture, and the potential is medium for this use. Common and improved bermudagrasses are well suited to these soils. The potential is low for cultivated crops. Erosion is the main hazard. Terraces and farming on the contour are needed to help reduce soil loss. Leaving crop residue on the surface of these soils helps to conserve soil moisture. The potential is medium for range. Proper stocking and controlled grazing are needed in management of range. The potential is high for wildlife habitat.

These soils have high potential for most urban uses. The low strength is the main limitation, but this can be overcome by proper design of structures. The potential is medium for recreation development. An adequate cover of grasses is needed to help keep the soil from blowing. Slope is a limitation for playgrounds.

These soils are in capability subclass IVe and Sandy Loam range site.

38—Heaton loamy fine sand, 1 to 5 percent slopes. This deep, gently sloping, sandy soil is on low ridges. Areas are oval and range from 8 to 150 acres.

Typically, the surface layer is neutral, yellowish brown loamy fine sand about 8 inches thick. Below this to a depth of 28 inches is neutral, light brown loamy fine sand. From 28 to 53 inches is medium acid, yellowish red sandy clay loam, and from 53 to 65 inches is medium acid, reddish yellow sandy clay loam.

This soil is well drained. Runoff is slow. Permeability is moderate, and available water capacity is medium. The hazard of water erosion is moderate, and soil blowing is a hazard if the soil is bare.

Included with this soil in mapping are small areas of Konsil and Gasil soils that are on the outer edges of areas and have a thinner surface layer than the Heaton soil. The included soils make up less than 20 percent of any area.

Areas of this soil are used mainly for pasture. The potential is medium for this use and for cultivated crops. Leaving crop residue on the surface of this soil helps to reduce soil blowing and conserve moisture.

The potential is low for range. Proper stocking and controlled grazing help to maintain a fair stand of native grasses. The potential is high for wildlife habitat.

This soil has high potential for most urban uses. The rolling topography and native trees are attractive to home builders.

The potential is medium for most recreation uses. Soil blowing is the major hazard. This can be overcome by maintaining an adequate grass cover on recreation areas.

This soil is in capability subclass IIIe and Sandy range site.

39—Heiden clay, 1 to 3 percent slopes. This deep, gently sloping, clayey soil is on uplands. Areas are mainly oval and range from 20 to about 200 acres. Areas of this soil that have not been disturbed have gilgai microrelief consisting of microknolls and microdepressions. The microknolls are 3 to 10 inches higher than the microdepressions, and the center of the microknolls is 10 to 20 feet from the center of the microdepressions.

In the center of a microknoll, this moderately alkaline soil, typically, has a surface layer of dark grayish brown clay about 5 inches thick. Below this to a depth of 50 inches is clay. From 5 to 14 inches the clay is dark grayish brown, from 14 to 24 inches it is olive, from 24 to 40 inches it is grayish brown, and from 40 to 50 inches it is grayish brown and has yellowish brown mottles. Between depths of 50 and 60 inches is mottled yellowish brown, light olive brown, and gray shaly clay.

This soil is well drained. Runoff is rapid. Permeability is very slow, and available water capacity is high. The hazard of erosion is slight. This soil is difficult to work during either extreme in content of soil moisture. Continuous tillage at the same depth and tillage when the soil is wet cause a plowpan to develop, which slows the movement of roots, air, and water.

Included with this soil in mapping are small areas of Houston Black soils mainly on the lower, less sloping part of the landscape. The included soils make up less than about 20 percent of any area.

Areas of this soil are used for cultivated crops, pasture, and range. The potential is high for these uses. Terraces and farming on the contour help to reduce the hazard of erosion. Cover crops are beneficial in maintaining tilth. Leaving crop residue on the surface of this soil helps to maintain soil moisture. The potential is medium for wildlife habitat.

This soil has low potential for urban uses. The shrink-swell potential, low strength, and clayey texture are the main limitations.

The potential is low for recreation development. The clayey texture and very slow permeability are the main limitations. An adequate grass cover and loamy fill material are needed in recreation areas to overcome the clayey texture.

This soil is in capability subclass IIe and Blackland range site.

40—Heiden clay, 3 to 5 percent slopes. This deep, gently sloping, clayey soil is on convex ridges and side slopes of ridges. Areas are oblong and range from 10 to about 100 acres. Areas that have not been disturbed have gilgai microrelief consisting of microknolls and microdepressions (fig. 8). The microknolls are 3 to 8 inches higher than the microdepressions, and the center of the microknolls is 10 to 18 feet from the center of the microdepressions.

Typically, this moderately alkaline soil has a surface layer of dark grayish brown clay about 12 inches thick. Below this to a depth of 36 inches is light olive brown clay, and from 36 to 56 inches is yellowish brown clay.

Figure 8.—Native grass on Heiden clay, 3 to 5 percent slopes, showing microrelief.

Between depths of 56 and 65 inches is brownish yellow and light brownish gray shaly clay.

This soil is well drained. Runoff is rapid. Permeability is very slow, and available water capacity is high. The hazard of erosion is moderate. This soil is difficult to work during either extreme in content of soil moisture. Tillage when the soil is wet causes a plowpan to develop, which slows the movement of roots, air, and water.

Included with this soil in mapping are small areas of Normangee soils on the lower parts of slopes. The included soils make up less than 15 percent of any area.

Areas of this soil are used mainly for pasture and range. The potential is high for these uses. Proper stocking and controlled grazing are needed in management of range. Control of mesquite trees is needed in some areas. The potential is medium for cultivated crops, and small grain and grain sorghum are grown in a few areas. Terraces and farming on the contour are needed to help control erosion. Leaving crop residue on the surface of this soil helps reduce erosion and improve tilth. The potential is medium for wildlife habitat.

This soil has low potential for most urban uses. The shrink-swell potential, low strength, clayey texture, and very slow permeability are the major limitations. Good design and proper installation of structures is essential on this soil. The potential is low for recreation development. The very slow permeability and clayey texture are the main limitations. A loamy fill material is needed in recreation areas, and an adequate grass cover should be maintained.

This soil is in capability subclass IIIe and Blackland range site.

41—Howe silty clay loam, 5 to 8 percent slopes. This moderately deep, sloping, loamy soil is on convex ridges. Areas are oblong to oval and 10 to about 60 acres.

Typically, the surface layer is grayish brown, moderately alkaline silty clay loam about 7 inches thick. Below this to a depth of 36 inches is moderately alkaline silty clay loam. From 7 to 15 inches the silty clay loam is light gray, and from 15 to 26 inches it is very pale brown and has about 27 percent soft, platy, chalk fragments. The underlying material is white, platy chalk (fig. 9).

Figure 9.—Profile of Howe silty clay loam showing platy chalk fragments at a depth of about 20 inches and massive chalk below.

This soil is well drained. Runoff is medium. Permeability is moderate, and available water capacity is low. The hazard of erosion is severe.

Included with this soil in mapping are small areas of Altoga soils on the lower parts of the landscape above drainageways, Austin soils in less sloping areas, and Whitewright soils on parts of the landscape similar to Howe soils, but have less depth. The included soils make up less than 15 percent of any area.

Areas of this soil are dominantly used for pasture. The potential is medium for this use. Improved bermudagrasses are well suited to this soil. The potential is low for cultivated crops. Erosion is a major hazard on cropland. The potential is high for range and is medium for wildlife habitat. Proper stocking and controlled grazing are needed in management of range.

This soil has medium potential for most urban uses. The moderate depth, shrink-swell potential, and corrosivity to uncoated steel are the major limitations. The potential is low for septic tank filter fields because of the depth to rock. The potential is medium for recreation development. The clayey texture is the major limitation.

This soil is in capability subclass IVe and Clay Loam range site.

42—Konsil loamy fine sand, 1 to 5 percent slopes. This deep, gently sloping, sandy soil is on low ridges. Areas are oval and range from 10 to 90 acres.

Typically, the surface layer is pale brown, mildly alkaline loamy fine sand about 7 inches thick. Below this to a depth of 11 inches is light brown, neutral loamy fine sand. From 11 to 26 inches is red, slightly acid sandy clay loam. Between depths of 26 and 65 inches is red, medium acid sandy clay loam.

This soil is well drained. Runoff is slow. Permeability is moderate, and available water capacity is medium. The hazard of erosion is slight, but unprotected areas are subject to blowing.

Included with this soil in mapping are small areas of Gasil soils and soils that have a surface layer of fine sandy loam. The included soils make up less than 20 percent of any area.

Most areas of this soil are used for pasture. The potential is medium for this use. Improved bermudagrasses are suited to this soil. The potential is medium for cultivated crops. Returning crop residue to the surface of this soil and using cover crops in the cropping system help to reduce soil blowing and conserve moisture. The potential is medium for range and is high for wildlife habitat. Proper stocking and controlled grazing are needed in the management of range.

This soil has high potential for most urban uses. The low strength is the main limitation. The potential is

medium for septic tank filter fields because of the moderate permeability. The potential is medium for most recreation uses. A cover of grass that is sufficient to prevent this sandy soil from blowing is needed.

This soil is in capability subclass IIIe and Sandy Loam range site.

43—Konsil fine sandy loam, 2 to 5 percent slopes. This deep, gently sloping, loamy soil is on ridges. Areas are oblong and range from about 8 to 75 acres.

Typically, the surface layer is brown, neutral fine sandy loam about 9 inches thick. Below this to a depth of 65 inches is sandy clay loam. From 9 to 23 inches the sandy clay loam is yellowish red and slightly acid, from 23 to 35 inches it is yellowish red and slightly acid and has reddish brown mottles, from 35 to 56 inches it is yellowish red and medium acid and has strong brown mottles, and from 56 to 65 inches it is reddish yellow and medium acid.

This soil is well drained. Runoff is slow. Permeability is moderate, and available water capacity is high. The hazard of erosion is moderate.

Included with this soil in mapping are small areas of Callisburg and Gasil soils. The included soils make up less than about 20 percent of any area.

Areas of this soil are used mainly for pasture. The potential is medium for this use. Common and improved bermudagrasses are the main grasses used for pasture.

The potential is medium for cultivated crops. Terraces and farming on the contour help to reduce erosion on cropland. Leaving crop residue on the surface of this soil helps to conserve moisture.

The potential is medium for range and is high for wildlife habitat. Proper stocking and controlled grazing are needed in the management of range.

This soil has high potential for most urban uses. The main limitation is low strength, but this can be easily overcome by good design and installation of structures. The potential is medium for septic tank filter fields because of the moderate permeability.

The potential is high for most recreation uses, but is medium for playgrounds because of the slope.

This soil is in capability subclass IIIe and Sandy Loam range site.

44—Konsil fine sandy loam, 5 to 8 percent slopes. This deep, sloping, loamy soil is on convex ridges. Areas are smooth, mainly oblong, and range from about 7 to 50 acres.

Typically, the surface layer is brown, neutral fine sandy loam about 8 inches thick. Below this to a depth of 12 inches is strong brown, slightly acid fine sandy loam. Between depths of 12 and 63 inches is red sandy clay loam. The sandy clay loam is medium acid to a depth of 56 inches and slightly acid below a depth of 56 inches.

This soil is well drained. Runoff is medium. Permeability is moderate, and available water capacity is high. The hazard of erosion is moderate.

Included with this soil in mapping are small areas of Callisburg, Crosstell, and Gasil soils. The included soils make up less than about 20 percent of any area.

Areas of this soil are used mainly for pasture. The potential is medium for this use. Common and improved bermudagrasses are the main grasses used for pasture.

The potential is low for cultivated crops. Terraces and farming on the contour help to reduce erosion on cropland. Leaving crop residue on the surface of the soil helps to conserve moisture.

The potential is medium for range and is high for wildlife habitat. Proper stocking and controlled grazing are needed in the management of range.

This soil has high potential for most urban uses. The main limitation is low strength, but this can be easily overcome by good design and installation of structures. The potential is medium for septic tank filter fields because of the moderate permeability.

The potential is high for most recreation uses, but is medium for playgrounds because of the slope.

This soil is in capability subclass IVe and Sandy Loam range site.

45—Konsil fine sandy loam, 5 to 8 percent slopes, eroded. This deep, sloping, loamy soil is on convex ridges and side slopes along streams. Areas are oval or oblong and range from about 10 to 65 acres. This soil is dissected by gullies and rills that are 6 to 24 inches deep and 50 to 250 feet apart. The gullies are crossable by farm machinery.

Typically, the surface layer is reddish brown, slightly acid fine sandy loam about 4 inches thick. Below this to a depth of 63 inches is sandy clay loam. From 4 to 26 inches the sandy clay loam is red and medium acid, from 26 to 46 inches it is red and strongly acid, and from 46 to 63 inches it is light red and strongly acid.

This soil is well drained. Runoff is rapid. Permeability is moderate, and available water capacity is high. The hazard of erosion is severe.

Included with this soil in mapping are small severely eroded areas of Konsil and Gasil soils and small areas of Callisburg and Crosstell soils. The included soils make up less than 20 percent of any area.

Areas of this soil are used mainly for pasture. The potential is medium for this use. Common and improved bermudagrasses are the main grasses used for pasture.

This sloping, eroded soil is not suitable for cultivated crops.

The potential is medium for range and is high for wildlife habitat. Proper stocking and controlled grazing are needed in the management of range.

This soil has high potential for most urban uses. The main limitation is low strength, but this can be easily overcome by good design and installation of structures. Eroded areas need shaping and smoothing in places. The potential is medium for septic tank filter fields because of the moderate permeability.

The potential is high for most recreation uses, but is medium for playgrounds because of the slope.

This soil is in capability subclass VIe and Sandy Loam range site.

46—Lewisville silty clay, 1 to 3 percent slopes. This deep, gently sloping, clayey soil is on terraces along major streams. Areas are mainly oval and range from 10 to 60 acres.

Typically, the surface layer of this moderately alkaline soil is dark grayish brown silty clay about 19 inches thick. Below this to a depth of 38 inches is grayish brown silty clay and from 38 to 70 inches is very pale brown silty clay.

This soil is well drained. Runoff is medium. Permeability is moderate, and available water capacity is high. The hazard of erosion is slight.

Included with this soil in mapping are small areas of Altoga and Heiden soils. The included soils make up less than 20 percent of any area.

Areas of this soil are used mainly for pasture and cultivated crops, but a few areas are in native range. The potential is high for these uses. Leaving crop residue on the surface of this soil helps to maintain moisture for cultivated crops. Terraces and farming on the contour help to reduce erosion in cropland. Proper stocking and controlled grazing are needed in management of range. The potential is medium for wildlife habitat.

This soil has medium potential for most urban uses. The shrink-swell potential, corrosivity to uncoated steel, and low strength are the main limitations. These limitations can be overcome by proper design and installation of structures. The potential is medium for septic tank filter fields because of the moderate permeability. The potential is medium for recreation development. The clayey surface layer is a limitation. A suitable stand of grass and the use of loamy fill material in recreation areas help to overcome this limitation.

This soil is in capability subclass IIe and Clay Loam range site.

47—Lewisville silty clay, 3 to 5 percent slopes. This deep, gently sloping, clayey soil is on terraces along major streams. Areas are mainly oblong and range from about 10 to 60 acres.

Typically, the surface layer of this moderately alkaline soil is dark grayish brown silty clay about 11 inches thick. Below this to a depth of 60 inches is silty clay. To a depth of 26 inches the silty clay is grayish brown, and below a depth of 26 inches it is very pale brown.

This soil is well drained. Runoff is medium. Permeability is moderate, and available water capacity is high. The hazard of erosion is moderate.

Included with this soil in mapping are small areas of Altoga and Austin soils. The included soils make up less than 20 percent of any area.

Areas of this soil are used mainly for pasture. The potential is high for this use. Common and improved bermudagrasses are suited to this soil.

The potential is high for cultivated crops. Erosion is the main hazard. Terraces and farming on the contour are needed on cropland to reduce the erosion hazard. Leaving crop residue on the surface of this soil helps to reduce runoff and maintain moisture. The potential is high for range and medium for wildlife habitat. Proper stocking and controlled grazing are needed in the management of range.

This soil has medium potential for most urban uses. The shrink-swell potential and low strength are the main limitations. These limitations can be overcome by proper design and installation of structures. The potential is medium for septic tank filter fields because of the moderate permeability.

The potential is medium for recreation development. The clayey surface layer is a limitation. Maintenance of an adequate grass cover and use of loamy fill material in recreation areas help to overcome this limitation.

This soil is in capability subclass IIIe and Clay Loam range site.

48—Lindy loam, 1 to 3 percent slopes. This moderately deep, gently sloping, loamy soil is on low ridges. Areas are oval and range from 10 to 50 acres.

Typically, the surface layer is dark brown, neutral loam about 8 inches thick. Below this to a depth of a depth of 31 inches is reddish brown, mildly alkaline clay, and below a depth of 31 inches is hard limestone.

This soil is well drained. Runoff is medium. Permeability is slow, and available water capacity is low. The hazard of erosion is slight.

Included with this soil in mapping are small areas of Bolar soils. The included soils make up less than 15 percent of any area.

Areas of this soil are used for pasture and for range. The potential is medium for pasture. Improved bermudagrasses and King Ranch bluestem are suited to this soil. The potential is high for range. Proper stocking and controlled grazing are needed in the management of range. The potential is medium for cultivated crops. The depth to rock and low available water capacity are limitations for cultivated crops. Leaving crop residue on the surface of this soil helps to reduce erosion and conserve moisture.

This soil has medium potential for urban development. Low strength, shrink-swell potential, and depth to rock are the main limitations. The potential is low for septic tanks because of the depth to rock and slow permeability. The potential is medium for recreation uses. The slow permeability and large stones are the main limitations.

This soil is in capability subclass IIIe and Deep Redland range site.

49—Lindy-Urban land complex, 1 to 3 percent slopes. This complex consists of gently sloping soils on low ridges. Areas are oblong and range from 10 to 45 acres.

This complex is made up of about 55 percent Lindy loam, 30 percent Urban land, and 15 percent soils of

minor extent. The Lindy soils and Urban land are so intricately mixed that to separate them at the scale used in mapping was not practical.

Typically, the Lindy soil has a surface layer of dark brown, neutral loam about 8 inches thick. Below this to a depth of 31 inches is reddish brown, mildly alkaline clay, and below a depth of 31 inches is hard limestone.

The Lindy soils are well drained and have medium runoff. Permeability is slow, and available water capacity is low.

Urban land consists of some commercial buildings, multiple unit dwellings, single unit dwellings, and the adjoining streets, sidewalks, and driveways. The soils have been disturbed during construction, and in many areas fill material has been added to lawns.

The Lindy soils have medium potential for most urban uses. The depth to rock and corrosivity to uncoated steel are the main limitations.

This complex is not assigned to a capability subclass or a range site.

50—Mabank loam, 0 to 1 percent slopes. This deep, nearly level, loamy soil is in broad areas on uplands. Areas are oval or oblong and range from 10 to 200 acres.

Typically, the surface layer is dark grayish brown and grayish brown, medium acid loam about 8 inches thick. Below this to a depth of 58 inches is mildly alkaline or moderately alkaline clay. From 8 to 37 inches the clay is dark gray, and from 37 to 58 inches it is gray. Below a depth of 58 inches is light gray, slightly acid clay that has brownish yellow mottles.

This soil is somewhat poorly drained. Runoff is slow. Permeability is very slow, and available water capacity is medium. The hazard of erosion is slight.

Included with this soil in mapping are small areas of Crockett soils on the slightly higher parts of the landscape and Wilson soils on the same parts of the landscape as the Mabank soil. The included soils make up less than 15 percent of any area.

Areas of this soil are used mostly for cultivated crops. The potential is medium for this use. Leaving crop residue on the surface of this soil helps to conserve moisture and improve tilth. The potential is high for pasture. Improved bermudagrasses are suited to this soil. The potential is medium for range and wildlife habitat. Proper stocking and controlled grazing are needed to maintain a good stand of grasses.

This soil has low potential for urban development. The shrink-swell potential, low strength, corrosivity to uncoated steel, and wetness are the major limitations. Good design and careful installation of structures is needed. The potential is low for septic tank filter fields because of the very slow permeability. The potential is low for recreation uses. Wetness is the main limitation. Artificial drainage and maintenance of an adequate cover of grasses in recreation areas help to overcome this limitation.

This soil is in capability subclass IIIw and Claypan Prairie range site.

51—Mabank loam, 1 to 3 percent slopes. This deep, gently sloping, loamy soil is on uplands. Areas are irregular in shape and range from 10 to 90 acres.

Typically, the surface layer is grayish brown, neutral loam about 5 inches thick. Below this to a depth of 18 inches is very dark gray, neutral clay. From 18 inches to a depth of more than 60 inches is moderately alkaline clay. To a depth of 32 inches the clay is dark gray, between 32 and 51 inches it is light brownish gray and has light olive brown mottles, and from 51 to a depth of more than 60 inches it is mottled olive brown, yellowish brown, and gray.

This soil is somewhat poorly drained. Runoff is medium. Permeability is very slow, and available water capacity is medium. The hazard of erosion is moderate.

Included with this soil in mapping are small areas of Crockett soils on the slightly higher parts of the landscape and Wilson soils on about the same part of the landscape as the Mabank soil. The included soils make up less than 15 percent of any area.

Areas of this soil are used for cultivated crops and pasture. The potential is medium for cultivated crops. Returning crop residue to the surface of this soil helps to conserve moisture and improve tilth. Terraces and farming on the contour are needed to help control erosion in areas of row crops. The potential is high for pasture. Improved bermudagrasses are well suited to this soil. The potential is medium for range and for wildlife habitat. Controlled grazing is needed on range to help maintain plant vigor.

This soil has low potential for urban development. The shrink-swell potential, wetness, and low strength are the major limitations. These limitations can be overcome by good design and proper installation of structures. The potential is low for septic tank filter fields because of the very slow permeability. The potential is low for recreation uses. Wetness is the major limitation. Artificial drainage and maintenance of an adequate grass cover in recreation areas help to overcome this limitation.

This soil is in capability subclass IIIe and Claypan Prairie range site.

52—Normangee clay loam, 1 to 4 percent slopes. This deep, gently sloping, loamy soil is on broad uplands. Areas are irregular in shape and range from 15 to about 250 acres.

Typically, the surface layer is dark grayish brown, medium acid clay loam about 7 inches thick. Below this to a depth of 45 inches is medium acid clay. From 7 to 15 inches the clay is brown and has reddish brown mottles, from 15 to 34 inches it is grayish brown and has red and yellowish brown mottles, and from 34 to 45 inches it is light yellowish brown and has gray mottles. Between depths of 45 and 55 inches is light olive brown, moderately alkaline clay that has gray mottles, and

below this to a depth of 65 inches is mottled olive yellow and grayish brown, moderately alkaline shaly clay.

This soil is moderately well drained. Runoff is medium. Permeability is very slow, and available water capacity is high. The hazard of erosion is moderate.

Included with this soil in mapping are small spots of Wilson and Mabank soils on slightly lower parts of the landscape and Crockett soils on the same part of the landscape as the Normangee soil. The included soils make up less than 15 percent of any area.

Areas of this soil are used for cultivated crops and for pasture. The potential is medium for cultivated crops. Terraces help to control erosion in areas of cropland. Leaving crop residue on the surface of this soil helps to conserve moisture. The potential is high for pasture. Improved bermudagrasses are suited to this soil. The potential is medium for range and is low for wildlife habitat. Controlled grazing is important in maintenance of a good stand of grasses.

This soil has medium potential for urban uses. The shrink-swell potential and low strength are the major limitations. These limitations can be overcome by good design and careful installation of structures. The potential is low for septic tank filter fields because of the very slow permeability. The potential is medium for recreation uses. The clayey surface layer is the main limitation. Maintenance of an adequate cover of grasses in recreation areas helps to overcome this limitation.

This soil is in capability subclass IIIe and Claypan Prairie range site.

53—Normangee clay loam, 4 to 8 percent slopes. This deep, sloping loamy soil is on uplands. Areas are oblong and range from 15 to 80 acres.

Typically, the surface layer is dark brown, slightly acid clay loam about 4 inches thick. Below this to a depth of 16 inches is yellowish brown, slightly acid clay that has dark red mottles. Between depths of 16 and 46 inches is grayish brown, neutral clay that has red mottles, and from 46 to a depth of 50 inches is mottled red and gray, mildly alkaline shaly clay.

This soil is moderately well drained. Runoff is rapid. Permeability is very slow, and available water capacity is high. The hazard of erosion is severe.

Included with this soil in mapping are small areas of Crockett soils on slightly lower parts of the landscape and Callisburg and Vertel soils on the same part of the landscape as the Normangee soil. The included soils make up less than 15 percent of any area.

Areas of this soil are mainly used for pasture. The potential is high for this use. Improved bermudagrasses and King Ranch bluestem are suited to this soil. Proper grazing is important to maintain vigorous plant growth. This soil is not suitable for cultivated crops. The potential is medium for range and low for wildlife habitat. Proper stocking and controlled grazing are needed to maintain vigor in range grasses.

This soil has medium potential for urban uses. The shrink-swell potential and low strength are the main limitations. Good design and proper installation of structures is needed to overcome these limitations. The potential is low for septic tank filter fields because of the very slow permeability. The potential is low for recreation uses. The clayey surface layer and slope are the main limitations. An adequate cover of grasses is needed for recreation areas.

This soil is in capability subclass VIe and Claypan Prairie range site.

54—Normangee-Urban land complex, 1 to 4 percent slopes. This complex consists of gently sloping soils on uplands. Areas are oval and range from 20 to 200 acres.

This complex is made up of about 60 percent Normangee soils, 25 percent Urban land, and 15 percent soils of minor extent. The Normangee soils and Urban land are so intricately mixed that to separate them at the scale used in mapping was not practical.

Typically, the Normangee soil has a surface layer of dark grayish brown, medium acid clay loam about 7 inches thick. Below this to a depth of 45 inches is medium acid clay. From 7 to 15 inches the clay is brown and has reddish brown mottles, from 15 to 34 inches it is grayish brown and has red and yellowish brown mottles, and from 34 to 45 inches it is light yellowish brown and has gray mottles. Between depths of 45 and 55 inches is light olive brown, moderately alkaline clay that has gray mottles, and below this to a depth of 65 inches is mottled olive yellow and grayish brown, moderately alkaline shaly clay.

The Normangee soils are moderately well drained. Runoff is medium. Permeability is very slow, and the available water capacity is high. The hazard of erosion is moderate.

Urban land consists of single unit dwellings and the adjoining streets, driveways, sidewalks, and patios. In some areas, especially in areas that have steeper slopes, cutting, filling, leveling, and other disturbances have so obscured the soils that their identification and classification are not practical.

Included with the Normangee soil and Urban land in mapping are mainly Wilson, Crockett, and Vertel soils.

The soils in this complex have medium potential for urban uses. The high shrink-swell potential and slow permeability are the major limitations. These limitations can be overcome by good design and proper maintenance of structures. Temporary terraces, diversions, and other management practices are needed during construction to help protect bare areas from erosion.

This complex is not assigned to a capability subclass or a range site.

55—Normangee soils, 3 to 8 percent slopes, severely eroded. These deep, gently sloping to sloping, loamy soils are on severely eroded ridges and side slopes along streams. Areas are long and narrow and range from 10 to 80 acres. These soils have gullies that

are 30 to 140 feet apart, 6 to 30 feet wide, and 1 to 5 feet deep. Many of the gullies cannot be crossed by farm machinery. In some areas, the texture of the surface layer is variable because of the erosion, and along the gullies, the clay layer in the lower part of the profile is exposed. The extent of these soils in mapped areas is not uniform, and the pattern in which the soils occur is not regular.

Typically, the surface layer of the Normangee soil is dark grayish brown, neutral clay loam about 3 inches thick. Below this to a depth of 22 inches is light yellowish brown, slightly acid clay that has many red mottles. From 22 to 43 inches is light yellowish brown, mildly alkaline clay that has common brownish yellow mottles. From 43 inches to a depth of 50 inches is mottled brownish yellow and light gray, moderately alkaline shale.

These soils are moderately well drained. Runoff is rapid. Permeability is very slow, and available water capacity is high. The hazard of erosion is severe.

Included with these soils in mapping are severely eroded areas of Wilson and Crockett soils. The included soils make up less than 20 percent of any area.

Areas of these soils are used mainly for range. Most areas have been cultivated, but now have a sparse stand of common bermudagrass, silver bluestem, and threeawn. The potential is medium for range. These soils are not suited to cultivated crops. The potential is medium for pasture. Improved bermudagrasses and King Ranch bluestem are suited to this soil. The shaping and smoothing of gullies is needed so that areas can be easily crossed by farm machinery. The potential is low for wildlife habitat.

These soils have medium potential for most urban uses. The shrink-swell potential and low strength are the major limitations. Shaping and smoothing of the gullies is needed before urban use. The potential is low for septic tank filter fields because of the very slow permeability. The potential is low for most recreation uses because of the clayey texture and very slow permeability. An adequate cover of grasses helps to overcome these limitations.

These soils are in capability subclass VIe and Claypan Prairie range site.

56—Okay fine sandy loam, 0 to 1 percent slopes. This deep, nearly level, loamy soil is on broad stream terraces. Areas are oval and average about 40 acres.

Typically, the surface layer is brown, mildly alkaline fine sandy loam about 12 inches thick. Below this to a depth of 65 inches is medium acid sandy clay loam. From 12 to 21 inches the sandy clay loam is brown, from 21 to 32 inches it is light brown, and from 32 to 65 inches it is reddish yellow.

This soil is well drained. Runoff is slow. Permeability is moderate, and available water capacity is medium. The hazard of erosion is slight.

Included with this soil in mapping are small areas of Bastrop and Oklared soils. The included soils make up less than 20 percent of any area.

Areas of this soil are used for cultivated crops and for pasture. The potential is high for these uses. Leaving crop residue on the surface of this soil helps to conserve moisture. Improved bermudagrasses are well suited to this soil. The potential is high for range and for wildlife habitat. Controlled grazing and proper stocking are needed in the management of range.

This soil has high potential for urban uses and for recreation uses.

This soil is in capability class I and Sandy Loam range site.

57—Oklared very fine sandy loam. This deep, nearly level, loamy soil is on low stream terraces. Areas are oblong and average about 40 acres. Slope is mainly less than 1 percent.

Typically, the surface layer is brown, moderately alkaline very fine sandy loam about 7 inches thick. Below this to a depth of 11 inches is light reddish brown, moderately alkaline very fine sandy loam. Between depths of 11 and 19 inches is reddish brown, moderately alkaline loam. From 19 to 50 inches is reddish brown, moderately alkaline fine sandy loam, and below this to a depth of 74 inches is yellowish red, moderately alkaline loamy fine sand.

This soil is well drained. Runoff is slow. Permeability is moderately rapid, and available water capacity is medium. The hazard of erosion is slight, and the hazard of flooding is rare.

Included with this soil in mapping are small areas of Bastrop and Okay soils. The included soils make up less than 20 percent of any area.

Areas of this soil are used for pasture and for cultivated crops. The potential is high for these uses. Leaving crop residue on the surface of this soil helps to conserve moisture. The potential is high for range and for wildlife habitat. Proper stocking and controlled grazing are needed in management of range.

This soil has low potential for most urban uses because of the rare flooding. The potential is high for most recreation development. It is low for camp areas because of the flooding.

This soil is in capability class I and Loamy Bottomland range site.

58—Oklared-Kiomatia complex, occasionally flooded. These nearly level to gently sloping, loamy and sandy soils are on flood plains and low terraces along the Red River. Areas are oblong and range from 50 to about 500 acres. Slope is 0 to 2 percent. These soils are subject to brief flooding once every 7 to 10 years.

This complex is made up of about 54 percent Oklared soils and soils that are similar to Oklared soils and 46 percent Kiomatia soils and soils that are similar to Kiomatia soils. Areas of these soils are so intricately mixed that to separate them at the scale used in mapping was not practical.

Typically, the Oklared soil has a surface layer of brown, moderately alkaline very fine sandy loam about 7

inches thick. Below this to a depth of 16 inches is brown, moderately alkaline very fine sandy loam. Between depths of 16 and 23 inches is reddish brown, moderately alkaline silty clay loam. From 23 to 38 inches is pink, moderately alkaline very fine sand, and below this to a depth of 65 inches is pink, moderately alkaline fine sand.

This Oklared soil is well drained. Runoff is slow. Permeability is moderately rapid, and available water capacity is medium. The hazard of erosion is slight.

Typically, the Kiomatia soil has a surface layer of light brown, moderately alkaline loamy fine sand about 7 inches thick. Below this to a depth of 20 inches is light brown, moderately alkaline fine sand; from 20 to 35 inches is light brown, moderately alkaline very fine sand; and from 35 inches to a depth of 80 inches is pink, moderately alkaline very fine sand. All layers below a depth of 7 inches have strata of loam and silt loam (fig. 10).

Figure 10.—Profile of Kiomatia fine sand. Continuous bedding planes are below a depth of about 30 inches.

This Kiomatia soil is well drained. Runoff is slow. Permeability is rapid. Available water capacity is low, and the hazard of erosion is slight. The unprotected soil is subject to soil blowing.

Included with these Oklared and Kiomatia soils in mapping are small areas of Bastrop soils. The included soils make up less than 20 percent of any area.

Areas of these soils are used for pasture. The potential is high for this use. Improved bermudagrasses are well suited to these soils. The potential is medium for cultivated crops. Leaving crop residue on the surface of these soils helps to control soil blowing. The potential is medium for range and for wildlife habitat. Proper stocking and controlled grazing are needed in the management of range.

These soils have low potential for most urban development. Flooding is a major hazard. The potential is medium for most recreation uses. Occasional flooding is a hazard, and the sandy surface layer is a major limitation. The potential is low for camp areas because of the flooding.

These soils are in capability subclass IIIs. The Oklared soil is in Loamy Bottomland range site, and the Kiomatia soil is in Sandy Bottomland range site.

59—Pits. Pits are areas from which rock, sand and gravel, or clay has been removed for the construction of roads or other structures. These pits make up about 1,400 acres and are throughout the county. They range from 4 to 400 acres.

The largest pits are rock pits. They are in the limestone area in the northern part of the county. These pits range to 400 acres and have an average depth of 20 to 30 feet. Material mined from these pits was crushed and used as subgrade for roads and for construction. Rock pits are in the Sanger, Bolar, and Aledo soils.

The smaller pits occur where rock or sand and gravel was dug for local road and building use, or where clay was excavated for fill material along federal highways. Many of the smaller pits are in the Austin Chalk area. Along rivers, pits that were dug for sand and gravel have an average depth of 10 to 20 feet. The smaller rock pits are mainly in the Eddy and Whitewright soils. Most of the sand pits are in the Kiomatia, Oklared, Konsil, and Gasil soils. Pits that are too small to be shown as an area on the soil map are indicated by a special symbol.

Most pits remain open, and a plant cover is not maintained. The size and depth of the pit and type of spoil material in some pits can make revegetation very difficult. The clay pits contain water during much of the year.

The smaller sand pits, however, can be smoothed and revegetated.

This map unit is not assigned to a capability subclass or range site.

60—Purves clay loam, 1 to 5 percent slopes. This shallow, gently sloping, loamy soil is on low convex ridges. Areas are oblong and commonly range from 10 to 40 acres.

Typically, the surface layer is dark grayish brown, moderately alkaline clay loam about 8 inches thick. Below this to a depth of 14 inches is brown, moderately alkaline clay loam. Slightly fractured limestone is below a depth of 14 inches.

This soil is well drained. Runoff is medium. Permeability is moderately slow, and available water capacity is very low. The hazard of erosion is slight.

Included with this soil in mapping are small areas of Aledo soils on ridgetops and the higher parts of the landscape and Bolar soils on the slightly lower parts. The included soils make up less than 15 percent of any area.

Areas of this soil are used for pasture, and the potential is low for this use. King Ranch bluestem is suited to this soil. The potential is low for cultivated crops because of the depth to rock and very low available water capacity. Leaving crop residue on the surface of this soil helps conserve moisture. The potential is low for range and for wildlife habitat. Proper stocking and controlled grazing are needed in management of range.

This soil has medium potential for most urban uses. The depth to limestone and high shrink-swell potential are the main limitations. These limitations are difficult to overcome. The potential is low for septic tank systems because of the depth to limestone and moderately slow permeability. The potential is low for recreation uses because of the clayey texture.

This soil is in capability subclass IVe and Shallow range site.

61—Redlake clay, occasionally flooded. This deep, nearly level, clayey soil is on bottom lands. Areas are oval or oblong and range from 10 to 400 acres. Areas of this soil are subject to flooding for short periods once every 3 to 5 years; however, in some areas flooding is less frequent.

Typically, the surface layer is weak red, moderately alkaline clay about 8 inches thick. Below this to a depth of 60 inches is reddish brown, moderately alkaline clay. Below a depth of 37 inches the clay has thin strata of dark grayish brown silt loam.

This soil is moderately well drained. Runoff is slow. Permeability is very slow, and available water capacity is high. The hazard of erosion is slight.

Included with this soil in mapping are areas of Trinity and Oklared soils. The included soils make up about 15 percent of any area.

Areas of this soil are used mainly for pasture and for cultivated crops. Wheat and oats are the main cultivated crops. Improved bermudagrasses are suited to many areas. Returning crop residue to the surface of the soil helps to maintain tilth and conserve moisture. Drainage to remove excess water is a benefit in some small, low lying, concave areas. The potential is high for range and medium for wildlife habitat. Controlled grazing and proper stocking are needed in the management of range.

This soil has low potential for urban development because of the flood hazard and high shrink-swell potential. The potential is low for recreation development. Occasional flooding is a hazard, and the clay surface layer is a major limitation.

This soil is in capability subclass IIIw and Clayey Bottomland range site.

62—Sanger clay, 1 to 3 percent slopes. This deep, gently sloping, clayey soil is in valleys between limestone ridges. Areas are oval and range from about 15 to 100 acres. Areas that have not been tilled have gilgai microrelief that extends up and down the slope. The microrelief consists of microknolls 6 to 18 feet wide and microdepressions 4 to 12 feet wide. The microknolls are 3 to 10 inches higher than the microdepressions.

Typically, the surface layer is dark gray, moderately alkaline clay about 6 inches thick. Below this to a depth of 62 inches is moderately alkaline clay. From 6 to 47 inches the clay is grayish brown, and from 47 to 62 inches it is mottled brownish yellow, gray, and grayish brown.

This soil is well drained. Runoff is slow. Permeability is very slow, and available water capacity is high. The hazard of erosion is moderate.

Included with this soil in mapping are small spots of Bolar soils on the higher parts of the landscape. The included soils make up less than 20 percent of any area.

Areas of this soil are used mainly for range. The potential is high for this use. Proper stocking and controlled grazing are needed to maintain plant vigor. The potential is high for cultivated crops. Leaving crop residue on the surface of the soil helps to improve tilth and conserve moisture. The potential is high for pasture and is medium for wildlife habitat. Improved bermudagrasses are suited to this soil.

This soil has low potential for urban uses. The shrink-swell potential, corrosivity to uncoated steel, and low strength are the main limitations. Good design and careful installation of structures help to overcome the limitations. The potential for recreation uses is low because of the clayey texture.

This soil is in capability subclass IIe and Blackland range site.

63—Sanger clay, 3 to 5 percent slopes. This deep, gently sloping clayey soil is on the side slopes of ridges. Areas are oblong and range from about 15 to 90 acres. Areas that have not been tilled have gilgai microrelief that extends up and down the slope. The microrelief consists of microknolls 6 to 20 feet wide and micro-

depressions 4 to 12 feet wide. The microknolls are 3 to 10 inches higher than the microdepressions.

Typically, the surface layer is very dark gray, moderately alkaline clay about 7 inches thick. Below this to a depth of 49 inches is moderately alkaline clay. From 7 to 23 inches the clay is dark grayish brown, from 23 to 34 inches it is olive and has a few olive brown mottles, and from 34 to 49 inches it is olive and has pale olive mottles. Below this to a depth of 65 inches is mottled brownish yellow and light gray, moderately alkaline clay.

This soil is well drained. Surface runoff is medium. Permeability is very slow, and available water capacity is high. The hazard of erosion is moderate.

Included with this soil in mapping are small areas of Bolar soils on low ridges. The included soils make up less than 15 percent of any area.

Most areas of this soil are used for range. The potential is high for this use. Proper stocking and controlled grazing are needed to maintain plant vigor. The potential is high for cultivated crops. Terracing and farming on the contour are essential to help reduce erosion on cropland. Leaving crop residue on the surface of this soil helps to conserve moisture, reduce runoff, and improve tilth. The potential is high for pasture and medium for wildlife habitat. Bermudagrasses are well suited to this soil.

This soil has low potential for most urban uses. The shrink-swell potential, corrosivity to uncoated steel, and low strength are the main limitations. The clayey surface layer is the major limitation.

This soil is in capability subclass IIIe and Blackland range site.

64—Sanger stony clay, 3 to 8 percent slopes. This deep, stony, gently sloping to sloping, clayey soil is on side slopes of ridges. Areas are long and narrow and range from 30 to 400 acres. Areas that have not been tilled have gilgai microrelief that extends up and down the slope. The microrelief consists of microknolls 6 to 18 feet wide and microdepressions 3 to 12 feet wide. The microknolls are 3 to 12 inches higher than the microdepressions.

Typically, the surface layer is gray, moderately alkaline clay about 7 inches thick. Below this to a depth of 41 inches is moderately alkaline clay. From 7 to 14 inches the clay is dark grayish brown, and from 14 to 41 inches it is light olive brown. Below this to a depth of 60 inches is light yellowish brown, moderately alkaline clay. About 20 percent of the surface is limestone fragments 4 to 6 inches thick and 2 to 6 feet across.

This soil is well drained. Runoff is medium. Permeability is very slow, and available water capacity is high. The hazard of erosion is moderate.

Included with this soil in mapping are small areas of Bolar and Aledo soils on the steeper parts of slopes. The included soils make up less than about 10 percent of any area.

Areas of this soil are used for range. The potential is high for this use. Proper stocking and controlled grazing are needed in the management of range. The potential is low for wildlife habitat. This soil is not suited to cultivated crops or pasture. Stones have been worked into a vertical position by the shrinking and swelling of this soil. The stones are large, and they protrude 6 to 36 inches above the surface. Their removal is difficult.

This soil has low potential for urban uses. The shrink-swell potential, large stones, and low strength are the main limitations. Good design of structures is needed to help overcome these limitations. The soil potential is low for septic tank systems because of the very slow permeability. The potential is low for recreation uses because of the clayey surface layer and the large stones.

This soil is in capability subclass VIs and Blackland range site.

65—Speck Variant loam, 1 to 3 percent slopes. This shallow, gently sloping, loamy soil is on ridgetops. Areas are oval and range from 8 to 35 acres.

Typically, the surface layer is reddish brown, moderately alkaline loam about 5 inches thick. Below this to a depth of 15 inches is reddish brown, mildly alkaline clay, and from 15 to 18 inches is white, chalky limestone.

This soil is well drained. Runoff is medium. Permeability is slow, and available water capacity is very low. The hazard of erosion is moderate.

Included with this soil in mapping are small areas of Whitewright and Eddy soils along the outer edges of the mapped areas. The included soils make up less than 20 percent of any area.

Most areas of this soil are used for cultivated crops or for pasture along with the adjoining, deeper soils. The potential is low for these uses. The very low available water capacity in this soil reduces productivity. Leaving crop residue on the surface of this soil helps to reduce erosion and conserve moisture. The potential is low for range and for wildlife habitat. Proper stocking and controlled grazing are needed in management of range.

This soil has medium potential for most urban uses. The depth to rock and the shrink-swell potential are the main limitations. The potential is low for septic tank filter fields because of the slow permeability and shallow depth to rock. The potential is low for most recreation uses. The clayey texture and slow permeability are the major limitations.

This soil is in capability subclass IIIe and Redland range site.

66—Stephen silty clay, 1 to 3 percent slopes. This shallow, gently sloping, clayey soil is on convex ridges. Areas are oval and range from 5 to 120 acres.

Typically, the surface layer is very dark grayish brown, moderately alkaline silty clay about 13 inches thick. Below this to a depth of 18 inches is grayish brown, moderately alkaline very gravelly silty clay that has about 60 percent weakly cemented chalk fragments. Below a depth of 18 inches is white, platy chalk.

This soil is well drained. Runoff is medium. Permeability is moderately slow, and available water capacity is very low. The hazard of erosion is moderate.

Included with this soil in mapping are small areas of Whitewright soils. The included soils make up less than 15 percent of any area.

Areas of this soil are used mainly for cultivated crops. The potential is medium for this use. Erosion is a hazard, and the depth to rock is a limitation. Terraces and grassed waterways help to control runoff. Terraces are difficult to construct in this shallow soil. Returning crop residue to the surface of this soil helps to prevent erosion and conserve moisture. The potential is low for pasture. Depth to rock is the main limitation. Improved bermudagrasses are fairly well suited to this soil. The potential is low for range and medium for wildlife habitat. Restricted rooting depth is the main limitation. Controlled grazing and proper stocking of range are essential to maintain plant vigor.

This soil has medium potential for urban uses. The depth to rock is the main limitation, but the rock is soft and rippable and makes a good footing for foundations. The potential is low for septic tank filter fields because of the depth to rock. The potential is medium for recreation uses because of the depth to rock and clayey texture. Maintaining an adequate stand of grasses helps to reduce erosion in heavily used areas.

This soil is in capability subclass IIIe and Chalky Ridge range site.

67—Stephen silty clay, 3 to 5 percent slopes. This shallow, gently sloping, clayey soil is on uplands. Areas are generally oblong and range from 10 to 30 acres.

Typically, the surface layer is dark grayish brown, moderately alkaline silty clay about 7 inches thick. Below this to a depth of 14 inches is grayish brown, moderately alkaline silty clay loam that has weakly cemented chalk fragments. The underlying material is white, soft chalk that is platy in the upper 4 inches and massive below.

This soil is well drained. Runoff is medium. Permeability is moderately slow, and available water capacity is very low. The hazard of erosion is moderate.

Included with this soil in mapping are small areas of Eddy and Whitewright soils. The included soils make up less than 20 percent of any area.

Areas of this soil are mainly used for cultivated crops. Small grain is the chief crop. The potential is low for row crops and is medium for small grain. The soil depth is the main limitation. Erosion is a hazard. Close-growing crops and returning crop residue to the surface of this soil help to control erosion, conserve moisture, and maintain tilth and productivity. The potential is low for pasture. Depth to rock is the main limitation. Improved bermudagrasses are fairly well suited to this soil. The potential is low for range and medium for wildlife habitat. Restricted rooting depth is the major limitation.

This soil has medium potential for urban uses. The depth to rock is the main limitation, but the rock is soft and rippable and makes a good footing for foundations. The potential is low for septic tank filter fields because of the depth to rock. The potential is medium for recreation uses. The clayey texture is the main limitation.

This soil is in capability subclass IVe and Chalky Ridge range site.

68—Trinity clay, occasionally flooded. This deep, nearly level, clayey soil is on flood plains of major streams. Areas are oblong and range from 8 to 200 acres. This soil is subject to flooding of short duration about once in 5 to 10 years.

Typically, the surface layer is very dark gray, moderately alkaline clay about 36 inches thick. Below this to a depth of 65 inches is moderately alkaline clay. From 36 to 52 inches the clay is dark gray, and from 52 to 65 inches it is mottled light olive brown, olive brown, and dark grayish brown.

This soil is somewhat poorly drained. Runoff is very slow. Permeability is very slow, and available water capacity is high. The hazard of erosion is slight.

Included with this soil in mapping are small areas of Whitesboro and Elbon soils. The included soils make up less than 30 percent of any area.

Areas of this soil are used for cultivated crops and for pasture. The potential is high for these uses. Common and improved bermudagrasses are suited to this soil.

Crops planted early in spring can be damaged by ponding during wet periods in some years. Leaving crop residue on the surface of the soil helps to conserve moisture and improve tilth.

The potential is high for range and medium for wildlife habitat. Proper stocking and controlled grazing are needed in the management of range.

This soil has low potential for urban uses. Flooding is a hazard, and the shrink-swell potential and wetness are major limitations. The potential is low for septic tank filter fields because of the very slow permeability, wetness, and flooding. The potential is low for most recreation uses. Flooding is a hazard, and the clayey texture and very slow permeability are limitations.

This soil is in capability subclass IIw and Clayey Bottomland range site.

69—Urban land. This map unit makes up parts of the towns of Sherman and Denison and the Grayson County Airport. About 75 to 90 percent of the Urban land is covered with works and structures, such as office buildings, downtown areas, shopping centers, runways, railroad yards, and parking lots.

About 10 percent of this unit consists of single unit dwellings that cover 40 to 50 percent of the surface.

Installation of works and structures has so altered and obscured soil features that identification or classification of the soils is not feasible. The soil material in Sherman, however, represents soils that formed over chalk and shale; the soil material in Denison represents soils that formed over sandstone; and the soil material at the Airport represents soils that formed over shale.

This miscellaneous area is not assigned to a capability subclass or range site.

70—Vertel clay, 1 to 3 percent slopes. This moderately deep, gently sloping, clayey soil is on convex foot slopes. Areas are oblong and range from 10 to 85 acres. They follow the contour of the slope and are dissected by shallow drains. In areas that have not been tilled, this soil has gilgai microrelief consisting of microdepressions 1 to 3 feet wide and microknolls 10 to 16 feet wide. The microknolls are 2 to 8 inches higher than the microdepressions.

Typically, the surface layer is about 18 inches of grayish brown, neutral clay about 18 inches thick. Below this to a depth of 37 inches is olive, mildly alkaline clay that has yellowish brown mottles, and from 37 to a depth of 54 inches is mottled grayish brown and strong brown, moderately alkaline very shaly clay

This soil is well drained. Runoff is rapid. Permeability is very slow, and available water capacity is low. The hazard of erosion is moderate.

Included with this soil in mapping are small areas of Heiden soils. The included soils make up less than about 15 percent of any area.

Areas of this soil are used mainly for pasture and range, and some areas are used for cultivated crops. The potential is medium for these uses. Improved bermudagrasses and King Ranch bluestem are suited to this soil. Terracing and farming on the contour are needed to help control erosion. Returning crop residue to the surface of this soil helps to conserve moisture and reduce runoff. Proper stocking and controlled grazing are needed in the management of range. The potential is medium for wildlife habitat (fig. 11).

This soil has low potential for most urban uses. The high shrink-swell potential, corrosivity to uncoated steel, and low strength are the major limitations. These limitations can be overcome by good design and careful in-

Figure 11.—Geese grazing small grain on Vertel clay, 1 to 3 percent slopes.

stallation of structures. Bare areas need protection from erosion during construction. The potential is low for recreation uses. The clayey texture and very slow permeability are the main limitations.

This soil is in capability subclass IIIe and Eroded Blackland range site.

71—Vertel clay, 3 to 5 percent slopes. This moderately deep, gently sloping, clayey soil is on side slopes above drains and on gently undulating, low ridges. Areas are oblong and range from 8 to 200 acres. A few areas have rills or shallow gullies. In areas that have not been tilled, this soil has gilgai microrelief consisting of microdepressions 1 to 3 feet wide and microknolls 10 to 16 feet wide. The microknolls are 2 to 8 inches higher than the microdepressions.

Typically, the surface layer is grayish brown, mildly alkaline clay about 5 inches thick. Below this to a depth of 33 inches is olive, moderately alkaline clay that has yellowish brown mottles. From 33 to a depth of 54 inches is light olive brown and gray, moderately alkaline very shaly clay.

This soil is well drained. Runoff is rapid. Permeability is very slow, and available water capacity is low. The hazard of erosion is severe.

Included with this soil in mapping are small areas of Normangee and Heiden soils. The included soils make up less than 20 percent of areas.

Areas of this soil are used mainly for pasture and for range. The potential is medium for these uses. Proper stocking and controlled grazing are needed in the management of range. Improved bermudagrasses and King Ranch bluestem are suited to this soil. The potential is medium for wildlife habitat. The potential is low for cultivated crops. Terracing and farming on the contour are needed for cultivated crops. Leaving crop residue on the surface of this soil helps to reduce erosion and conserve soil moisture.

This soil has low potential for most urban uses. The high shrink-swell potential, corrosivity to uncoated steel, and low strength are the main limitations. These limitations can be overcome by good design and proper installation of structures. Bare areas need to be protected from erosion during construction. The potential is low for most recreation uses. The clayey texture and very slow permeability are the main limitations.

This soil is in capability subclass IVe and Eroded Blackland range site.

72—Vertel clay, 5 to 12 percent slopes. This moderately deep, sloping to strongly sloping, clayey soil is on convex ridges and side slopes along drains. Areas are oval and range from 15 to about 100 acres. Some areas have small eroded spots and small gullies. In areas that have not been tilled, this soil has gilgai microrelief consisting of microdepressions 1 to 3 feet wide and microknolls 10 to 16 feet wide. The microknolls are 2 to 8 inches higher than the microdepressions.

Typically, the surface layer is grayish brown, mildly alkaline clay about 8 inches thick. Below this to a depth of 34 inches is grayish brown, mildly alkaline clay that has light olive brown mottles. From 34 to a depth of 40 inches is light gray and light olive brown, moderately alkaline very shaly clay.

This soil is well drained. Runoff is rapid. Permeability is very slow, and available water capacity is low. The hazard of erosion is severe.

Included with this soil in mapping are small areas of Normangee and Heiden soils. The included soils make up less than 20 percent of any area.

Areas of this soil are used for range. The potential is medium for this use. Proper stocking and controlled grazing are needed to maintain the stand of grasses. The potential is low for pasture. Common and improved bermudagrasses are suited to this soil. The potential is medium for wildlife habitat. This soil is not suited to cultivated crops.

This soil has low potential for most urban uses. The slope, shrink-swell potential, and low strength are the main limitations. These limitations are difficult to overcome. The potential is low for recreation uses. The slope, very slow permeability, and clayey texture are limitations that are difficult to overcome.

This soil is in capability subclass VIe and Eroded Blackland range site.

73—Vertel clay, 5 to 8 percent slopes, severely eroded. This moderately deep, sloping, clayey soil is on severely eroded uplands. Areas are rectangular and range from 10 to about 120 acres. This soil has a series of gullies, 20 to 80 feet apart, that are 4 to 20 feet wide and 2 to 10 feet deep. Most of the gullies cannot be crossed by farm machinery.

Typically, the surface layer is grayish brown, moderately alkaline clay about 6 inches thick. Below this to a depth of 38 inches is moderately alkaline clay. From 6 to 18 inches the clay is light brownish gray and from 18 to 38 inches it is brownish yellow. Below this to a depth of 54 inches is pale yellow and yellow very shaly clay.

This soil is well drained. Runoff is rapid. Permeability is very slow, and available water capacity is low. The hazard of erosion is severe.

Included with this soil in mapping are small areas of Vertel clay that are not severely eroded. Also included are severely eroded areas of Heiden soils. The included soils make up less than 10 percent of areas.

Most areas of this soil are used for pasture. The potential is low for this use. Common and improved bermudagrasses are fairly well suited. This soil is not suited to cultivated crops. The potential is medium for range and low for wildlife habitat. Proper stocking and controlled grazing are needed in the management of range.

This soil has low potential for urban uses. The high shrink-swell potential, presence of gullies, and low strength of this soil are the major limitations. The potential is low for recreation uses. The clayey texture and very slow permeability are the main limitations.

This soil is in capability subclass VIe and Eroded Blackland range site.

74—Vertel-Urban land complex, 8 to 12 percent slopes. This complex consists of strongly sloping soils on convex ridges and side slopes along drains. Areas are oblong and about 100 acres.

This complex is made up of about 50 percent Vertel soils, 35 to 40 percent Urban land, and less than 15 percent soils of minor extent. The soils and Urban land are so intricately mixed that to separate them at the scale used in mapping was not practical.

Typically, the Vertel soil has a surface layer of grayish brown, mildly alkaline clay about 5 inches thick. Below this to a depth of 33 inches is olive, moderately alkaline clay that has yellowish brown mottles. From 33 to a depth of 54 inches is olive brown and gray, moderately alkaline very shaly clay.

The Vertel soil is well drained. Runoff is rapid. Permeability is very slow, and available water capacity is low. The hazard of erosion is severe.

Urban land consists of single unit dwellings and the adjoining streets, sidewalks, and patios. In some areas, especially in sloping areas, the cutting, filling, leveling, and other disturbances have so obscured the soils that their identification and classification are not practical.

Included with the Vertel soils and Urban land in mapping are small areas of Heiden and Normangee soils.

The soils in this complex have low potential for urban uses. The slope, high shrink-swell potential, and low strength are the main limitations. These limitations are difficult to overcome. Bare areas need to be protected from erosion during construction.

This complex is not assigned to a capability subclass or a range site.

75—Whitesboro loam, occasionally flooded. This deep, nearly level, loamy soil is on narrow flood plains of streams. Areas are oblong and range from 20 to 150 acres. This soil is subject to brief flooding one or more times in 3 to 5 years during spring and fall.

Typically, the surface layer is dark grayish brown, neutral loam about 19 inches thick. Below this to a depth of 27 inches is dark grayish brown, slightly acid sandy clay loam that has gray and reddish brown mottles. Between depths of 27 and 39 inches is brown, slightly acid clay loam that has reddish brown and gray mottles, and below a depth of 39 inches is mottled gray and reddish yellow, moderately alkaline sandy clay loam.

This soil is moderately well drained. Runoff is slow. Permeability is moderate, and available water capacity is high. The hazard of erosion is slight.

Included with this soil in mapping are small areas of Bunyan and Whitesboro soils that are flooded more frequently than this Whitesboro soil. The included soils make up less than 20 percent of any area.

Areas of this soil are used mainly for pasture. The potential is high for this use. Improved bermudagrasses are well suited to this soil. The potential is high for cultivated crops. Leaving crop residue on the surface of this soil helps to conserve soil moisture. The potential is high for range and for wildlife habitat. Proper stocking and controlled grazing are needed in the management of range.

This soil has low potential for urban uses. Flooding is the major hazard, but adequate protection from flooding is difficult to provide. The potential is low for recreation development. Flooding is a hazard, and wetness is a major limitation.

This soil is in capability subclass IIw and Loamy Bottomland range site.

76—Whitewright-Eddy-Howe complex, 1 to 5 percent slopes. These very shallow to moderately deep, gently sloping soils are on convex chalky ridges. Areas are oval and range from 15 to 150 acres.

This complex is made up of about 46 percent Whitewright soils, 28 percent Eddy soils, 18 percent Howe soils, and 8 percent soils of minor extent. These soils are so intricately mixed that to separate them at the scale used in mapping was not practical.

Typically, the Whitewright soil has a surface layer of grayish brown, moderately alkaline silty clay loam about 7 inches thick. Below this to a depth of 11 inches is brown, moderately alkaline silty clay loam, and from 11 to a depth of 15 inches is brown, moderately alkaline, very gravelly silty clay loam. Below a depth of 15 inches is platy chalk. The chalk becomes massive as the depth increases.

Typically, the Eddy soil has a surface layer of brown, moderately alkaline gravelly clay loam about 4 inches thick. Below this to a depth of 9 inches is brown, moderately alkaline very gravelly clay loam that has about 80 percent chalk fragments. Below a depth of 9 inches is massive chalk.

Typically, the Howe soil has a surface layer of grayish brown, moderately alkaline silty clay loam about 14 inches thick. Below this to a depth of 29 inches is light brownish gray, moderately alkaline silty clay loam. Below a depth of 29 inches is platy chalk.

The soils in this complex are well drained. Runoff is rapid. Permeability is moderate to moderately slow, and available water capacity is very low or low. The hazard of erosion is moderate.

Included with these soils in mapping are small areas of Austin soils.

Areas of this complex are used for pasture and for range. The potential is low for these uses. Common and improved bermudagrasses and King Ranch bluestem are suited to these soils. The potential is low for wildlife habitat and for cultivated crops. The rooting depth and the low or very low available water capacity restrict plant growth.

These soils have medium potential for urban development. The depth to rock is the major limitation. The potential is low for septic tanks because of the depth to

rock. The potential is medium for recreation development. The small stones and clayey texture are the major limitations.

This complex is in capability subclass IVe. The Whitewright and Eddy soils are in Chalky Ridge range site, and the Howe soil is in Clay Loam range site.

77—Whitewright-Eddy-Howe complex, 5 to 12 percent slopes. These very shallow to moderately deep, sloping to strongly sloping soils are on sides of ridges along drains. Areas are long and narrow or oval and range from 20 to 300 acres.

This complex is made up of about 41 percent Whitewright soils, 28 percent Eddy soils, 25 percent Howe soils, and 6 percent soils of minor extent. These soils are so intricately mixed that to separate them at the scale used in mapping was not practical.

Typically, the Whitewright soil has a surface layer of light brownish gray, moderately alkaline silty clay loam about 5 inches thick. Below this to a depth of 16 inches is very pale brown, moderately alkaline silty clay loam. Below a depth of 16 inches is platy chalk.

Typically, the Eddy soil has a surface layer of light brownish gray, moderately alkaline gravelly clay loam about 5 inches thick. Below this to a depth of 11 inches is light brownish gray, moderately alkaline very gravelly clay loam that has about 70 percent chalk fragments. Below a depth of 11 inches is platy chalk.

Typically, the Howe soil has a surface layer of pale brown, moderately alkaline silty clay loam about 5 inches thick. Below this to a depth of 14 inches is grayish brown, moderately alkaline silty clay loam. From 14 to 22 inches is pale brown, moderately alkaline silty clay loam, and below a depth of 22 inches is platy chalk.

The soils in this complex are well drained. Runoff is rapid. Permeability is moderate to moderately slow, and available water capacity is very low to low. The hazard of erosion is severe.

Included with these soils in mapping are small areas of Altoga soils on the lower part of slopes.

Areas of this complex are used mainly for pasture and for range. The potential is low for these uses. Common and improved bermudagrasses and King Ranch bluestem are suited to these soils. Proper stocking and controlled grazing are needed in the management of range. The potential is low for wildlife habitat. These soils are not suited to cultivated crops.

The soils in this complex have medium potential for urban development. The slope and depth to rock are the main limitations. The potential is low for septic tank filter fields because of the depth to rock. The potential is low for most recreation development. The clayey texture and slope are the main limitations.

This complex is in capability subclass VIe. The Whitewright and Eddy soils are in Chalky Ridge range site, and the Howe soil is in Clay Loam range site.

78—Whitewright-Gullied land complex. This map unit consists of gullied, shallow, sloping to strongly sloping soils on the side slopes of chalk ridges. Slope ranges from 5 to about 10 percent. Areas are long and narrow and range from 10 to 150 acres. The soils have gullies that are 2 to 8 feet deep, 15 to 35 feet wide, and 20 to 100 feet apart (fig. 12). In the gullies, the underlying chalk is exposed.

This complex has an average composition of about 43 percent Whitewright soils and soils that are similar to Whitewright soils, 30 percent exposed chalk in gullies, and 27 percent soils of minor extent. The extent of these soils and Gullied land in areas is not uniform and the pattern in which they occur is not regular.

Typically, the Whitewright soil has a surface layer of grayish brown, moderately alkaline silty clay loam about 4 inches thick. Below this to a depth of 12 inches is pale brown, moderately alkaline silty clay loam, and below a depth of 12 inches is platy chalk.

These soils are well drained. Runoff is rapid. Permeability is moderate, and available water capacity is very low. The hazard of erosion is severe.

Included with these soils in mapping are areas of Eddy and Howe soils.

Most areas of these soils are used for range. Some areas are used for bermudagrass pasture. The potential is low for pasture. Areas need to be shaped and smoothed and planted to grasses. Common or improved bermudagrasses are suited to this soil. The potential is low for range and for wildlife habitat. Proper stocking and controlled grazing are needed in the management of range. The soils in this complex are not suited to cultivated crops.

The Whitewright soils and Gullied land have low potential for urban development. Shaping and smoothing of the gullies is needed. The shallow depth to rock is a major limitation. The potential is low for most recreation uses. Gullies and the clayey surface layer are the major limitations.

This complex is in capability subclass VIe. Whitewright soils are in Chalky Ridge range site, Gullied land is not assigned to a range site.

79—Wilson silty clay loam, 0 to 1 percent slopes. This deep, nearly level, loamy soil is on old broad terraces. Areas are elongated and range from 15 to about 500 acres.

Typically, the surface layer is dark gray, medium acid silty clay loam about 8 inches thick. Below this to a depth of more than 57 inches is silty clay. From 8 to 25 inches the silty clay is dark gray and neutral, between 25 and 34 inches it is gray and mildly alkaline, and from 34 to 57 inches it is gray and neutral. Below a depth of 57 inches the silty clay is mottled light brownish gray, brownish yellow, and gray and is neutral.

This soil is somewhat poorly drained. Runoff is slow. Permeability is very slow, and available water capacity is high. The hazard of erosion is slight.

Included with this soil in mapping are small areas of Mabank soils. The included soils make up less than 10 percent of any area.

Areas of this soil are used for cultivated crops and for pasture. The potential is medium for cultivated crops. Leaving crop residue on the surface of this soil helps to conserve soil moisture. The potential is high for pasture. Improved bermudagrasses are well suited to this soil. The potential is medium for range and for wildlife habitat. Proper stocking and controlled grazing are needed in the management of range.

This soil has low potential for most urban uses. The high shrink-swell potential, low strength, and wetness are the main limitations. The potential is low for septic tank filter fields because of the very slow permeability. The potential is low for most recreation uses. The very slow permeability and wetness are the main limitations.

This soil is in capability subclass IIIw and Claypan Prairie range site.

Figure 12.—Area of Whitewright-Gullied land complex showing large bare area of chalk extending from edges of gully.

80—Wilson silty clay loam, 1 to 3 percent slopes. This deep, gently sloping, loamy soil is on old terraces. Areas are oblong and range from 10 to 150 acres.

Typically, the surface layer is dark gray, neutral silty clay loam about 6 inches thick. Below this to a depth of 44 inches is mildly alkaline silty clay. From 6 to 25 inches the silty clay is dark gray, and from 25 to 44 inches it is gray. Between depths of 44 and 62 inches is light brownish gray, moderately alkaline silty clay, and from 62 to a depth of 80 inches is mottled yellowish brown, light gray, and grayish brown, moderately alkaline shaly clay.

This soil is somewhat poorly drained. Runoff is slow. Permeability is very slow, and available water capacity is high. The hazard of erosion is moderate.

Included with this soil in mapping are small areas, less than 10 acres, of Mabank and Crockett soils. The included soils make up 5 to 15 percent of most areas.

Areas of this soil are used for pasture and for cultivated crops. The potential is high for pasture. Common and improved bermudagrasses are suited to this soil. The potential is medium for cultivated crops (fig. 13). Leaving crop residue on the surface of this soil helps to maintain tilth and conserve moisture. The potential is medium for range and for wildlife habitat. Proper stocking and controlled grazing are needed in management of range.

This soil has low potential for most urban uses. The high shrink-swell potential, wetness, and low strength are the major limitations. The potential is low for septic tank filter fields because of the very slow permeability. The potential is low for recreation uses. The very slow permeability and wetness are the main limitations.

This soil is in capability subclass IIIe and Claypan Prairie range site.

81—Zilaboy soils, frequently flooded. These deep, nearly level, clayey soils are on flood plains of the major streams. Areas are long and narrow and average about

Figure 13.—Cotton on Wilson silty clay loam, 1 to 3 percent slopes.

3,000 acres. These soils are flooded two to four times a year for a period of 2 to 7 days, mainly in spring and fall.

Typically, the surface layer of a Zilaboy soil is dark grayish brown, slightly acid clay about 5 inches thick. Below this to a depth of 70 inches is clay. From 5 to 18 inches the clay is olive gray and slightly acid, from 18 to 40 inches it is grayish brown and slightly acid, from 40 to 55 inches it is olive and neutral, and from 55 to 70 inches it is olive and mildly alkaline.

These soils are somewhat poorly drained. Runoff is very slow. Permeability is very slow, and available water capacity is high. The hazard of erosion is slight.

Included with these soils in mapping are small areas of Trinity and Whitesboro soils. The included soils make up less than 25 percent of any area.

Areas of these soils are used for pasture and for range. The potential is high for these uses. Common and improved bermudagrasses are suited to these soils. Controlled grazing and control of brush are needed in management of range. The potential is medium for wildlife habitat. These soils flood and are not suited to cultivated crops.

These soils have low potential for urban uses. The flooding is a major hazard. The potential is low for recreation uses. Flooding is a hazard, and the clayey texture is a major limitation.

These soils are in capability subclass Vw and Clayey Bottomland range site.

Use and management of the soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavior characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops, pasture, and range; as sites for buildings, sanitary facilities, highways, and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land used on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

Crops and pasture

General management needed for crops and pasture is suggested in this section. The system of land capability classification used by the Soil Conservation Service is explained, and the estimated yields of the main crops and hay and pasture plants are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under "Soil maps for detailed planning." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

The potential of the soils in Grayson County is good for increased production of food. Food production could be increased by extending the latest crop production technology to all cropland in the county.

The acreage in crops and pasture has gradually been decreasing as more land is used for urban development. At present, an estimated 35,000 acres is in urban uses, and this figure is growing each year. The use of this soil survey to help make land use decisions that will influence the future role of farming in the county is discussed in the section "General soil map for broad land use planning."

Soil erosion is the major problem on about three-fourths of the cropland and pastureland in Grayson County.

Loss of the surface layer through erosion is damaging for two reasons. First, productivity is reduced as the surface layer is lost and part of the subsoil is incorporated into the plow layer. Loss of the surface layer is especially damaging on soils that have a clayey subsoil, such as Crockett, Crosstell, Mabank, and Normangee soils. It is also especially damaging on soils that have a layer in or below the subsoil that limits the depth of the root zone, such as the rock in Howe and Whitewright soils. Second, soil erosion on farmland results in sediment entering streams and ponds. Control of erosion minimizes the pollution of streams and ponds by sediment and improves the quality of water for livestock, for municipal use, for recreation, and for fish and wildlife.

In many sloping fields, preparing a good seedbed and tilling are difficult on clayey spots because the original surface layer has been eroded away. Such spots are common in areas of eroded Crockett and Crosstell soils.

Maintenance of a protective surface cover on the soil helps to control erosion, reduce runoff, and increase

infiltration. A cropping system that keeps plant cover on the surface for extended periods helps to hold soil erosion losses to an amount that will not reduce the productive capacity of the soil. On livestock farms, the legume and grass forage crops in the cropping system reduce erosion on sloping land and also provide nitrogen and improve tilth for the following crop.

Minimizing tillage and leaving crop residue on the surface help to increase infiltration and reduce the hazards of runoff and erosion. These practices can be adapted to most soils in the survey area but are more difficult to use successfully on the eroded soils and on the soils that have a clayey surface layer, such as Vertel, Heiden, Houston Black, and Fairlie soils. A no-tillage system for grain sorghum is effective in reducing erosion on sloping land and can be adapted to most soils in the survey area.

Terraces and diversions reduce the length of slope and reduce runoff and erosion. Parallel terraces fitted to the use of modern farm equipment eliminate point rows and are easier to farm. Parallel terraces can be used on most of the soils in Grayson County.

Soil blowing is a hazard on the sandy Heaton, Kiomatia, and Gasil soils. Soil blowing can damage soils if winds are strong and the soils are dry and bare of vegetation or surface mulch. Maintaining plant cover, surface mulch, or rough surfaces through proper tillage minimizes soil blowing on these soils.

Information and technical assistance for the design of erosion control practices for each kind of soil is available in local offices of the Soil Conservation Service.

Tilth is important to the germination of seeds and the infiltration of water into the soil. Soils that have good tilth are granular and porous.

Some of the soils used for cultivated crops form a crust on the surface after periods of intense rainfall. The crust is hard when dry and nearly impervious to water. Once the crust forms it reduces infiltration and increases runoff. Regular additions of crop residue, manure, and other organic material help to improve tilth and reduce crust formation.

If the clayey soils are wet when plowed, they tend to become very cloddy when dry, making good seedbeds very difficult to prepare. Plowing these soils at an optimum soil moisture condition and regular additions of crop residue to the soil help to improve tilth.

The fertility of most soils in the survey area can be increased by the addition of fertilizers, especially nitrogen and phosphorus. Some of the soils are low in potassium. On all soils, additions of fertilizer should be based on the results of soil tests, on the need of the crop, and on the expected level of yields. The Cooperative Extension Service and the Soil Conservation Service can help in determining the kinds and amounts of fertilizer to apply.

Yields per acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 6. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green-manure crops; and harvesting that insures the smallest possible loss.

For yields of irrigated crops, it is assumed that the irrigation system is adapted to the soils and to the crops grown, that good quality irrigation water is uniformly applied as needed, and that tillage is kept to a minimum.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 6 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils.

Land capability classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor does it consider possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland and for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit. Only class and subclass are used in this survey. These levels are defined in the following paragraphs.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals

indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have slight limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e, w, s,* or *c,* to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w, s,* or *c* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

The acreage of soils in each capability class and subclass is shown in table 7. The capability classification of each map unit is given in the section "Soil maps for detailed planning."

Rangeland

A small percentage of Grayson County is in rangeland. In most areas the forage produced on rangeland is supplemented by pasture, crop stubble, and small grain. In winter the native forage is supplemented with hay and protein concentrate.

The native vegetation in many parts of the survey area has been greatly depleted by continued excessive use. Some areas have been used for cultivated crops and have been abandoned. The grasses in the abandoned areas are generally of an inferior quality. Production of these areas could be greatly increased by good management.

In the northern part of the county, some soils are shallow over hard limestone. These soils support short and mid grasses, and have low production potential because of the shallow rooting depth. Other soils are steep or contain large stones. These soils support mid and tall grasses and have greater production than the shallow soils. In the central and southwestern parts of the county, the soils are deep and support a good growth of tall and mid grasses. In the southeastern part of the county, the soils are moderately deep and loamy. They support a good growth of mid and tall grasses.

The major management concern on most of the rangeland is control of grazing, so that the kinds and amounts of plants that make up the potential plant community are reestablished. Controlling weeds and brush are also important management concerns. If sound range management based on the soil survey information and rangeland inventories is applied, the potential is good for increasing the productivity of range in the area.

In areas that have similar climate and topography, differences in the kind and amount of vegetation produced on rangeland are closely related to the kind of soil. Effective management is based on the relationship between the soils and vegetation and water.

Table 8 shows, for each soil in the survey area, the range site; the total annual production of vegetation in favorable, normal, and unfavorable years; the characteristic vegetation; and the average percentage of each species. Only those soils that are used as or are suited to rangeland are listed. Explanation of the column headings in table 8 follows.

A *range site* is a distinctive kind of rangeland that produces a characteristic natural plant community that differs from natural plant communities on other range sites in kind, amount, and proportion of range plants. The relationship between soils and vegetation was established during this survey; thus, range sites generally can be determined directly from the soil map. Soil properties that affect moisture supply and plant nutrients have the greatest influence on the productivity of range plants. Soil reaction, salt content, and a seasonal high water table are also important.

Total production is the amount of vegetation that can be expected to grow annually on well managed rangeland that is supporting the potential natural plant community. It includes all vegetation, whether or not it is palatable to grazing animals. It includes the current year's growth of leaves, twigs, and fruits of woody plants. It does not include the increase in stem diameter of trees and shrubs. It is expressed in pounds per acre of air-dry vegetation for favorable, normal, and unfavorable years. In a favorable year, the amount and distribution of precipitation and the temperatures make growing conditions substantially better than average. In a normal year, growing conditions are about average. In an unfavorable year, growing conditions are well below average, generally because of low available soil moisture.

Dry weight is the total annual yield per acre reduced to a common percent of air-dry moisture.

Characteristic vegetation—the grasses, forbs, and shrubs that make up most of the potential natural plant community on each soil—is listed by common name. Under *composition*, the expected percentage of the total annual production is given for each species making up the characteristic vegetation. The amount that can be used as forage depends on the kinds of grazing animals and on the grazing season.

Range management requires a knowledge of the kinds of soil and of the potential natural plant community. It also requires an evaluation of the present range condition. Range condition is determined by comparing the present plant community with the potential natural plant community on a particular range site. The more closely the existing community resembles the potential community, the better the range condition. Range condition is an ecological rating only. It does not have a specific meaning that pertains to the present plant community in a given use.

The objective in range management is to control grazing so that the plants growing on a site are about the same in kind and amount as the potential natural plant community for that site. Such management generally results in the optimum production of vegetation, conservation of water, and control of erosion. Sometimes, however, a range condition somewhat below the potential meets grazing needs, provides wildlife habitat, and protects soil and water resources.

Recreation

The soils of the survey area are rated in table 9 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 9, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 9 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 12 and interpretations for dwellings without basements and for local roads and streets in table 11.

Camp areas require site preparation such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some light vehicular traffic. The best soils have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Paths and trails for hiking, horseback riding, and bicycling should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Wildlife habitat

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 10, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are wheat, oats, grain sorghum, soybeans, and sunflowers.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are fescue, lovegrass, ryegrass, clover, and vetch.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are bluestem, indiangrass, croton, ragweed, and switchgrass.

Shrubs are bushy woody plants that produce fruit, buds, twigs, bark, and foliage. Soil properties and features that affect the growth of shrubs are depth of the root zone, available water capacity, salinity, and soil moisture. Examples of shrubs are American beautyberry and possum haw.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, wild millet, sedges, and cattails.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are waterfowl feeding areas, wildlife watering developments, and beaver ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The wildlife attracted to these areas include bobwhite quail, mourning dove, songbirds, skunks, foxes, coyotes, and rabbits.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, herons, shore birds, kingfisher, mink, and beaver.

Habitat for rangeland wildlife consists of areas of shrubs and wild herbaceous plants. Wildlife attracted to rangeland include deer, thrushes, meadowlark, squirrels, raccoon, and opossum.

Engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations need to be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock,

hardness of bedrock within 5 to 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to (1) evaluate the potential of areas for residential, commercial, industrial, and recreation uses; (2) make preliminary estimates of construction conditions; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; (5) plan detailed onsite investigations of soils and geology; (6) locate potential sources of gravel, sand, earthfill, and topsoil; (7) plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and (8) predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

Building site development

Table 11 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, and local roads and streets. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock, a cemented pan, or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and the depth to the water table.

Dwellings and small commercial buildings are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrink-swell potential, and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 to 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material, a base of gravel, crushed rock, or stabilized soil material, and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock or to a cemented pan, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic supporting capacity.

Sanitary facilities

Table 12 shows the degree and the kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 12 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock or to a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to effectively filter the effluent. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 12 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

Excessive seepage due to rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground water pollution. Ease of excavation and revegetation needs to be considered.

The ratings in table 12 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area type sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Construction materials

Table 13 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet, and the depth to the water table is less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and *gravel* are used in great quantities in many kinds of construction. The ratings in table 13 provide guidance as to where to look for probable sources are based on the probability that soils in a given area contain sizable quantities of sand or gravel. A soil rated *good* or *fair* has a layer of suitable material at least 3 feet thick, the top of which is within a depth of 6 feet. Coarse fragments of soft bedrock material, such as shale and siltstone, are not considered to be sand and gravel. Fine grained soils are not suitable sources of sand and gravel.

The ratings do not take into account depth to the water table or other factors that affect excavation of the material. Descriptions of grain size, kinds of minerals, reaction, and stratification are given in the soil series descriptions and in table 15.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

Water management

Table 14 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas, and for embankments, dikes, and levees. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, irrigation, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of

stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock, to a cemented pan, or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and potential frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock or to a cemented pan, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, or sulfur. Availability of drainage outlets is not considered in the ratings.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock or to a cemented pan. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to reduce erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock or to a cemented pan affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of wind or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock or to a cemented pan affect the construction of grassed waterways. A hazard of wind erosion, low available water capacity, restricted rooting depth, toxic substances such as salts or sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

Soil properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics. These results are reported in table 15.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classifications, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

Engineering index properties

Table 15 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Soil series and morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture (*3*). These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If a soil contains particles coarser than sand, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system (*2*) and the system adopted by the American Association of State Highway and Transportation Officials (*1*).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as Pt. Soils exhibiting engineering properties of two groups can have a dual classification, for example, SP-SM.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of

grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

Rock fragments more than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an oven-dry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index are rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

Physical and chemical properties

Table 16 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, and plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earth-moving operations.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69.

The higher the value the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to wind erosion in cultivated areas. The groups indicate the susceptibility of soil to wind erosion and the amount of soil lost. Soils are grouped according to the following distinctions:

1. Sands, coarse sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.
2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible. Crops can be grown if intensive measures to control wind erosion are used.
3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

4L. Calcareous loamy soils that are less than 35 percent clay and more than 5 percent finely divided calcium carbonate. These soils are erodible. Crops can be grown if intensive measures to control wind erosion are used.

4. Clays, silty clays, clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control wind erosion are used.
5. Loamy soils that are less than 18 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible. Crops can be grown if measures to control wind erosion are used.
6. Loamy soils that are 18 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible. Crops can easily be grown.
7. Silty clay loams that are less than 35 percent clay and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible. Crops can easily be grown.
8. Stony or gravelly soils and other soils not subject to wind erosion.

Organic matter is the plant and animal residue in the soil at various stages of decomposition.

In table 16, the estimated content of organic matter of the plow layer is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter of a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

Soil and water features

Table 17 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the intake of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding, the temporary inundation of an area, is caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt and water in swamps and marshes is not considered flooding.

Table 17 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, common, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *common* that it is likely under normal conditions; *occasional* that it occurs on an average of once or less in 2 years; and *frequent* that it occurs on an average of more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; November-May, for example, means that flooding can occur during the period November through May.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter

content with increasing depth; and absence of distinctive horizons that form in soils that are not subject to flooding.

Also considered is local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 17 are the depth to the seasonal high water table; the kind of water table—that is, perched, artesian, or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 17.

An apparent water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. An artesian water table is under hydrostatic head, generally beneath an impermeable layer. When this layer is penetrated, the water level rises in an uncased borehole. A perched water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Only saturated zones within a depth of about 6 feet are indicated. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

Depth to bedrock is shown for all soils that are underlain by bedrock at a depth of 5 to 6 feet or less. For many soils, the limited depth to bedrock is a part of the definition of the soil series. The depths shown are based on measurements made in many soil borings and on other observations during the mapping of the soils. The kind of bedrock and its hardness as related to ease of excavation is also shown. Rippable bedrock can be excavated with a single-tooth ripping attachment on a 200-horsepower tractor, but hard bedrock generally requires blasting.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe corrosion environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low, moderate,* or *high,* is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

Soil series and morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the Soil Survey Manual (*3*). Many of the technical terms used in the descriptions are defined in Soil Taxonomy (*4*). Unless otherwise stated, colors in the descriptions are for dry soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Soil maps for detailed planning."

Aledo series

The Aledo series consists of very shallow and shallow, loamy soils on uplands. These soils formed in material weathered from limestone and marl. Slope ranges from 3 to 30 percent.

Typical pedon of Aledo gravelly clay loam, 3 to 8 percent slopes; from the junction of Farm Roads 1417 and 120 west of Denison, 0.2 mile west on Farm Road 120, 1.5 miles north on county road, and 300 feet west of road, in rangeland:

A11—0 to 3 inches; grayish brown (10YR 5/2) gravelly clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure; hard, friable; 20 percent fragments of limestone 2 millimeters to 1 inch across; calcareous; moderately alkaline; clear wavy boundary.

A12—3 to 8 inches; brown (10YR 5/3) very gravelly clay loam, dark brown (10YR 3/3) moist; moderate medium subangular blocky structure; hard, friable; about 50 percent fragments of limestone 2 millimeters to 2 1/2 inches across; calcareous; moderately alkaline; abrupt wavy boundary.

R—8 to 12 inches; hard, slightly fractured limestone.

The solum ranges from 8 to 15 inches in thickness. It is moderately alkaline and is calcareous.

The A11 horizon is grayish brown, dark grayish brown, very dark grayish brown, brown, or dark brown. It is clay

loam or gravelly clay loam. This horizon is 5 to 35 percent, by volume, fragments of limestone.

The A12 horizon is grayish brown, dark grayish brown, very dark grayish brown, brown, or dark brown. It is 35 to 80 percent, by volume, fragments of limestone.

The R layer is indurated, slightly fractured limestone.

Altoga series

The Altoga series consists of deep, loamy soils on terraces. These soils formed in calcareous clayey sediment. Slope ranges from 5 to 8 percent.

Typical pedon of Altoga clay loam, 5 to 8 percent slopes; from the intersection of U.S. Highways 69 and 82 in Bells, 2.4 miles west on U.S. Highway 82, 0.5 mile north on county road, 0.2 mile east on county road, and 40 feet south, in cultivated field:

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; hard, friable; calcareous; moderately alkaline; abrupt smooth boundary.

B21—6 to 32 inches; very pale brown (10YR 7/4) clay loam, light yellowish brown (10YR 6/4) moist; moderate fine granular and moderate fine subangular blocky structure; hard, friable; calcareous; moderately alkaline; gradual smooth boundary.

B22ca—32 to 43 inches; very pale brown (10YR 7/4) clay loam, light yellowish brown (10YR 6/4) moist; moderate fine granular and moderate fine subangular blocky structure; hard, friable; about 5 percent visible soft masses of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.

B3ca—43 to 65 inches; light yellowish brown (10YR 6/4) clay loam, yellowish brown (10YR 5/4) moist; weak fine granular structure; hard, friable; about 5 percent visible threads of calcium carbonate; calcareous; moderately alkaline.

The solum is 40 to 70 inches in thickness. Depth to soft bodies of calcium carbonate is 10 to 28 inches. The solum is clay loam throughout. It is moderately alkaline and is calcareous.

The A horizon is dark grayish brown, light brownish gray, brown, pale brown, or yellowish brown.

The B horizon is yellowish brown, light yellowish brown, very pale brown, or pale brown. In some pedons, it has a few brownish or light gray mottles below a depth of 40 inches. This horizon has 5 to 20 percent weakly cemented concretions, films and threads, or soft masses of calcium carbonate. In this horizon, calcium carbonate equivalent ranges from 40 to 70 percent.

Aubrey series

The Aubrey series consists of moderately deep, loamy soils on uplands. These soils formed in material weathered from acid clayey shale. Slope ranges from 3 to 12 percent.

Typical pedon of Aubrey stony fine sandy loam, in an area of Aubrey-Birome complex, 3 to 12 percent slopes; from the intersection of Farm Roads 120 and 996 in Pottsboro, 1.5 miles north on Farm Road 120, 0.9 mile west on county road, and 25 feet south of road, in oak woods:

A1—0 to 3 inches; dark yellowish brown (10YR 4/4) stony fine sandy loam, dark yellowish brown (10YR 3/4) moist; weak medium granular structure; hard, very friable; common medium and fine roots; about 30 percent fragments of ironstone and sandstone 2 millimeters to 6 inches across; neutral; clear smooth boundary.

A2—3 to 6 inches; light yellowish brown (10YR 6/4) stony fine sandy loam; yellowish brown (10YR 5/4) moist; weak medium granular structure; hard, very friable; common fine and medium roots; about 50 percent fragments of ironstone and sandstone 2 millimeters to 2 feet across; neutral; clear smooth boundary.

B21t—6 to 18 inches; red (2.5YR 5/6) clay, red (2.5YR 4/6) moist; few fine faint yellowish brown mottles; moderate medium blocky structure; hard, firm; cracks in the upper part contain coatings of material from the A horizon; common medium and fine roots; extremely acid; gradual smooth boundary.

B22t—18 to 32 inches; red (2.5YR 4/6) clay, dark red (2.5YR 3/6) moist; common coarse prominent yellowish brown (10YR 5/6) mottles; moderate medium blocky structure; hard, firm; few fine and medium roots; extremely acid; gradual smooth boundary.

Cr1—32 to 48 inches; mottled red (2.5YR 4/6), gray (10YR 6/1), and strong brown (7.5YR 5/6) moist, shaly clay; massive; hard, firm; extremely acid; gradual smooth boundary.

Cr2—48 to 60 inches; mottled dark yellowish brown (10YR 3/4), brown (7.5YR 4/4), and gray (N 6/0) moist, shale; massive; very hard, very firm; very strongly acid.

The solum is 20 to 40 inches in thickness.

The A horizon is fine sandy loam or stony fine sandy loam. It is brown, yellowish brown, or dark yellowish brown. This horizon is medium acid through neutral. A thin A2 horizon is present in most pedons and is slightly lighter in color than the A1 horizon.

The Bt horizon is red, yellowish red, reddish brown, or strong brown. It has contrasting mottles of red, yellowish red, yellowish brown, brownish yellow, light yellowish brown, reddish brown, strong brown, light brownish gray, grayish brown, or gray. The mottles range from none to few in the upper part of the Bt horizon and from few to common in the lower part. This horizon has 40 to 60 percent clay content. It is extremely acid through medium acid.

The Cr horizon is stratified shaly clay, clayey shale, or shale. It is mottled in shades of red, brown, gray, and yellow. This horizon is extremely acid through neutral.

Austin series

The Austin series consists of moderately deep, clayey soils on uplands. These soils formed in chalk. Slope ranges from 1 to 5 percent.

Typical pedon of Austin silty clay, 3 to 5 percent slopes; from the intersection of U.S. Highway 75 and county road in southwest edge of Howe, 2 miles west on county road to Hall Cemetery, and 50 feet north of cemetery, in pasture:

A1—0 to 11 inches; dark grayish brown (10YR 4/2) silty clay, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; hard, firm; few small chalk fragments; common roots; worm casts filled with lighter colored material; calcareous; moderately alkaline; clear smooth boundary.

B21—11 to 15 inches; grayish brown (10YR 5/2) silty clay, dark grayish brown (10YR 4/2) moist; moderate fine subangular blocky structure; hard, firm; few roots; few small chalk fragments; worm casts; calcareous; moderately alkaline; clear smooth boundary.

B22—15 to 22 inches; light brownish gray (2.5YR 6/2) silty clay, grayish brown (2.5Y 5/2) moist; moderate fine subangular blocky structure; hard, firm; few roots; few small chalk fragments; worm casts; few black concretions; calcareous; moderately alkaline; clear smooth boundary.

B3—22 to 30 inches; light gray (2.5Y 7/2) silty clay loam, light brownish gray (2.5Y 6/2) moist; weak fine subangular blocky structure; hard, firm; few roots; 35 percent small chalk fragments that slake in water; calcareous; moderately alkaline; abrupt wavy boundary.

Cr—30 to 36 inches; white (10YR 8/2) platy chalk.

The solum is 20 to 40 inches in thickness. It is silty clay, calcareous, and moderately alkaline throughout.

The A horizon is grayish brown, dark grayish brown, or very dark grayish brown.

The B horizon is grayish brown, light brownish gray, light gray, very pale brown, pale brown, light yellowish brown, yellowish brown, or brown.

The Cr horizon is white or light gray chalk that has hardness of less than three on Mohs' scale.

Bastrop series

The Bastrop series consists of deep, loamy soils on terraces. These soils formed in loamy sediment. Slope ranges from 0 to 3 percent.

Typical pedon of Bastrop loam, 1 to 3 percent slopes; from the intersection of Farm Roads 120 and 1753 east of Denison, 3.8 miles east on Farm Road 120 and 60 feet north of right-of-way, in idle field:

Ap—0 to 6 inches; reddish brown (5YR 5/4) loam, dark reddish brown (5YR 3/3) moist; weak medium granular structure; hard, very friable; many fine roots; neutral; clear smooth boundary.

B21t—6 to 18 inches; reddish brown (2.5YR 5/4) clay loam, dark reddish brown (2.5YR 3/4) moist; moderate medium subangular blocky structure; hard, friable; few roots; clay films; slightly acid; gradual smooth boundary.

B22t—18 to 34 inches; red (2.5YR 5/6) clay loam, dark red (2.5YR 3/6) moist; moderate medium subangular blocky structure; hard, friable; few roots; patchy clay films; few fine siliceous pebbles; medium acid; gradual smooth boundary.

B23t—34 to 62 inches; red (2.5YR 5/6) clay loam, red (2.5YR 4/6) moist; moderate medium subangular blocky structure; hard, friable; few roots; few patchy clay films bridging sand grains; few fine siliceous pebbles; slightly acid.

The solum is 60 to more than 75 inches in thickness.

The A horizon is yellowish brown, brown, or reddish brown. It is medium acid through neutral.

The Bt horizon is clay loam or sandy clay loam. It is reddish brown, red, yellowish red, or reddish yellow. The B21t horizon is slightly acid or neutral. The B22t and B23t horizons are medium acid through mildly alkaline.

Birome series

The Birome series consists of moderately deep, loamy soils on uplands. These soils formed in clayey and sandy sediment. Slope ranges from 3 to 12 percent.

Typical pedon of Birome stony fine sandy loam, in an area of Aubrey-Birome complex, 3 to 12 percent slopes; from the intersection of U.S. Highway 75 and Farm Road 120 in Denison, 4.9 miles west on Farm Road 120 and 30 feet north of right-of-way, in woods:

A1—0 to 4 inches; pale brown (10YR 6/3) stony fine sandy loam, brown (10YR 4/3) moist; moderate medium granular structure; hard, friable; common fine roots; about 15 percent fragments of ironstone 2 millimeters to 20 inches across the long axis; slightly acid; clear smooth boundary.

A2—4 to 8 inches; light yellowish brown (10YR 6/4) stony fine sandy loam, yellowish brown (10YR 5/4) moist; weak medium granular structure; hard, friable; common fine roots; about 10 percent fragments of ironstone 2 millimeters to 20 inches across the long axis; slightly acid; clear smooth boundary.

B21t—8 to 18 inches; red (2.5YR 4/6) clay, dark red (2.5YR 3/6) moist; moderate medium blocky structure; very hard, firm; few fine and medium roots; clay films; few fragments of sandstone and ironstone 2

millimeters to 2 inches across the long axis; extremely acid; gradual smooth boundary.

B22t—18 to 25 inches; red (2.5YR 5/6) clay, red (2.5YR 4/6) moist; few fine distinct strong brown mottles; moderate fine blocky structure; hard, firm; few fine and medium roots; clay films; few fragments of sandstone less than 1 inch across the long axis; extremely acid; gradual smooth boundary.

B3—25 to 31 inches; mottled reddish brown (2.5YR 4/4), brown (7.5YR 5/4), and yellowish brown (10YR 5/6) clay; moderate fine blocky structure; hard, firm; few fine roots; common sandstone fragments; extremely acid; clear wavy boundary.

Cr—31 to 35 inches; dark red (10R 3/6) and strong brown (7.5YR 5/8) brittle sandstone; extremely acid.

The solum ranges from 23 to 40 inches in thickness. Fragments of ironstone and sandstone, 2 millimeters to 30 inches across the long axis, make up 5 to 25 percent, by volume, of the solum.

The A horizon is pale brown, brown, or light reddish brown and is medium acid through neutral. The A2 horizon, where present, is very pale brown or light yellowish brown.

The Bt horizon is red or yellowish red. It has none to common mottles of brown, strong brown, yellowish brown, yellowish red, or dark red. This horizon is extremely acid through medium acid. The B3 horizon, where present, is mottled brown, yellowish brown, reddish brown, or red. It is clay or sandy clay and is extremely acid through medium acid.

The Cr horizon is brownish or reddish sandstone interbedded with red, gray, or brown shaly clay. It is extremely acid through medium acid.

Bolar series

The Bolar series consists of moderately deep, loamy soils on uplands. These soils formed in material weathered from interbedded limestone and marl. Slope ranges from 1 to 12 percent.

Typical pedon of Bolar clay loam, 1 to 5 percent slopes; from the intersection of Texas Highway 75A and Farm Road 84 in Denison, 6.1 miles northwest on Farm Road 84, 0.1 mile north on country road, 0.2 mile northeast on a road of the Corps of Engineers and 150 feet east, in rangeland:

A1—0 to 10 inches; brown (10YR 4/3) clay loam, dark brown (10YR 3/3) moist; moderate medium granular structure and moderate medium subangular blocky; hard, friable; common fine roots; about 5 percent fragments of limestone 1/2 inch to 5 inches across; calcareous; moderately alkaline; clear smooth boundary.

B21—10 to 22 inches; pale brown (10YR 6/3) clay loam, brown (10YR 5/3) moist; moderate medium granular and moderate medium subangular blocky structure; hard, firm; common fine roots; few fine calcium carbonate concretions; common fragments of limestone and fragments of shells; about 60 percent calcium carbonate equivalent; calcareous; moderately alkaline; gradual smooth boundary.

B22ca—22 to 33 inches; very pale brown (10YR 7/3) clay loam, pale brown (10YR 6/3) moist; moderate medium subangular blocky structure; hard, firm; few fine roots; about 20 percent visible soft masses and concretions of calcium carbonate; about 70 percent calcium carbonate equivalent; calcareous; moderately alkaline; gradual smooth boundary.

B3ca—33 to 37 inches; light gray (2.5Y 7/2) shaly clay; many fine yellow mottles; weak medium subangular blocky structure; hard, firm; few fine roots; about 25 percent visible soft masses and concretions of calcium; calcareous; moderately alkaline; abrupt wavy boundary.

R—37 to 40 inches; hard, slightly fractured limestone.

The solum ranges from 22 to 37 inches in thickness.

The A horizon is grayish brown, dark grayish brown, very dark grayish brown, brown, or very dark gray.

The B horizon is brown, dark grayish brown, pale brown, very pale brown, grayish brown, light brownish gray, light yellowish brown, light gray, or light olive brown. Mottles of yellowish brown or olive yellow range from none to common in the lower part of this horizon. This horizon is 5 to about 30 percent, by volume, visible soft masses and concretions of calcium carbonate, and it has 40 to 75 percent calcium carbonate equivalent.

The R horizon is fractured limestone that is interbedded with calcareous clayey marl.

Bunyan series

The Bunyan series consists of deep, loamy solid on flood plains. These soils formed in stratified alluvium. Slope is less than 1 percent.

Typical pedon of Bunyan fine sandy loam, in an area of Bunyan and Whitesboro soils, frequently flooded; from the intersection of U.S. Highway 82 and Farm Road 901 in south edge of Sadler, 7.8 miles north on Farm Road 901 and 800 feet east of right-of-way, in wooded pasture:

A11—0 to 22 inches; light yellowish brown (10YR 6/4) fine sandy loam, yellowish brown (10YR 5/4) moist; weak fine granular structure; slightly hard, very friable; common fine roots; neutral; clear smooth boundary.

A12—22 to 30 inches; yellowish brown (10YR 5/4) clay loam, dark yellowish brown (10YR 4/4) moist; moderate medium subangular blocky structure; hard, firm; common fine roots; slightly acid; gradual smooth boundary.

A13—30 to 48 inches; dark yellowish brown (10YR 4/4) clay loam, dark yellowish brown (10YR 3/4) moist,

few fine light brown mottles; weak medium subangular blocky structure; hard, firm; few fine roots; common thin strata of fine sandy loam; slightly acid; gradual smooth boundary.

C—48 to 65 inches; yellowish brown (10YR 5/4) loam, dark yellowish brown (10YR 4/4) moist; massive; hard, firm; few fine and medium roots; few thin yellowish red strata of fine sandy loam; neutral.

The 10-to 40-inch control section is fine sandy loam, loam, sandy clay loam, or clay loam. Stratification varies from scarcely evident to pronounced. Reaction ranges from medium acid through moderately alkaline.

The A horizon is dark grayish brown, grayish brown, brown, dark yellowish brown, yellowish brown, pale brown, or light yellowish brown. It is dominantly fine sandy loam or loam.

The C horizon is grayish brown, brown, pale brown, light yellowish brown, or yellowish brown. Mottles and strata of dark gray, reddish yellow, brown, and yellowish red range from few to many. The C horizon is sandy clay loam, fine sandy loam, loam, or clay loam.

Callisburg series

The Callisburg series consists of deep, loamy soils. These soils formed in clay and clayey shale. Slope ranges from 1 to 8 percent.

Typical pedon of Callisburg fine sandy loam, 2 to 5 percent slopes, eroded; from the intersection of U.S. Highway 377 and Texas Highway 56 in Whitesboro, south 5 miles on U.S. Highway 377, west 1.5 miles on county road, south 0.25 mile on county road, and 10 feet east, in pasture:

A1—0 to 5 inches; pale brown (10YR 6/3) fine sandy loam, brown (10YR 4/3) moist; weak medium granular structure; hard, friable; a few ironstone pebbles; neutral; clear smooth boundary.

B21t—5 to 16 inches; brown (7.5YR 5/4) sandy clay, brown (7.5YR 4/4) moist; moderate medium blocky structure; hard, firm; slightly acid; gradual smooth boundary.

B22t—16 to 27 inches; yellowish brown (10YR 5/4) sandy clay, dark yellowish brown (10YR 4/4) moist; common fine distinct reddish brown and few fine distinct red mottles; moderate medium blocky structure; hard, firm; medium acid; gradual smooth boundary.

B23t—27 to 50 inches; brownish yellow (10YR 6/6) sandy clay, yellowish brown (10YR 5/6) moist; few fine distinct red and few medium distinct light gray (10YR 6/1) mottles; moderate medium blocky structure; hard, firm; coatings of brown (10YR 5/3) on ped faces; medium acid; gradual smooth boundary.

B24t—50 to 62 inches; brownish yellow (10YR 6/6) sandy clay, yellowish brown (10YR 5/6) moist; common medium prominent strong brown (7.5YR 5/6) mottles; weak medium blocky structure; hard, firm; coatings of light gray (10YR 6/1) on ped faces; few pockets of uncoated sand grains; few black concretions; neutral.

The solum is more than 60 inches thick. Black concretions range from none to common.

The A horizon is brown, dark grayish brown, strong brown, pale brown, or yellowish brown. It is medium acid through neutral. A thin A2 horizon is present in some pedons. It has value of one or two units lighter than the A1 horizon.

The B21t horizon is brown, strong brown, brownish yellow, or yellowish brown. It is sandy clay loam or sandy clay and is strongly acid through neutral. The B22t and B23t horizons are brownish yellow, yellowish brown, light yellowish brown, brown, or reddish yellow. In these horizons, mottles of red, dark red, reddish yellow, yellowish red, yellowish brown, gray, or light gray range from none to common. The B22t and B23t horizons are sandy clay and are strongly acid through neutral.

Crockett series

The Crockett series consists of deep, loamy soils on uplands. These soils formed in alkaline marine clay. Slope ranges from 0 to 5 percent.

Typical pedon of Crockett loam, 2 to 5 percent slopes, eroded; from the intersection of Farm Roads 120 and 996 in Pottsboro, 1.1 miles north on Farm Road 120, 0.3 mile west on housing development road and 250 feet east of a fireplug, in idle field:

A1—0 to 4 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; hard, friable; common fine roots; medium acid; abrupt wavy boundary.

B21t—4 to 11 inches; mottled reddish brown (5YR 4/4) and dark grayish brown (10YR 4/2) clay; moderate medium blocky structure; very hard, very firm; few fine roots; few dark vertical streaks; slightly acid; clear wavy boundary.

B22t—11 to 23 inches; light olive brown (2.5Y 5/4) clay, olive brown (2.5Y 4/4) moist; few coarse faint light yellowish brown (2.5Y 6/4) moist mottles; moderate medium blocky structure; very hard, very firm; few fine roots; few dark vertical streaks; slightly acid; gradual wavy boundary.

B23t—23 to 30 inches; light olive brown (2.5Y 5/4) clay, olive brown (2/5Y 4/4) moist; moderate medium blocky structure; very hard, very firm; few fine roots; few dark vertical streaks; neutral; gradual wavy boundary.

B24t—30 to 44 inches; light olive brown (2.5Y 5/4) clay, olive brown (2.5Y 4/4) moist; moderate medium blocky structure; very hard, very firm; few fine roots; few dark vertical streaks; mildly alkaline; gradual wavy boundary.

B3—44 to 52 inches; light olive brown (2.5Y 5/4) clay, olive brown (2.5Y 4/4) moist; few medium faint yellowish brown (10YR 5/6) mottles; weak medium blocky structure; very hard, very firm; few fine roots; moderately alkaline; gradual wavy boundary.

C—52 to 65 inches; mottled yellowish brown (10YR 5/6), light brownish gray (10YR 6/2), and light olive brown (2.5Y 5/4) moist clay and horizontal lenses of shale; very hard, very firm; few films and threads of calcium carbonate; moderately alkaline.

The solum ranges from 40 to more than 60 inches in thickness.

The A horizon is dark brown, brown, very dark grayish brown, dark grayish brown, grayish brown, or light brownish gray. It is medium acid through neutral. A thin A2 horizon is present in a few pedons and is slightly lighter in color than the A1 horizon.

The Bt horizon is mottled in shades of reds, browns, olives, and yellows. The amount and distinctness of mottling varies greatly within a few feet. Visible forms of calcium carbonate range from none to few in the Bt horizon. This horizon is medium acid through mildly alkaline. The B3 horizon has the same colors as the Bt horizon. It is sandy clay or light clay.

The C horizon is shaly clay, clay, and stratified shale.

Crosstell series

The Crosstell series consists of deep, loamy soils. These soils formed in clay and material weathered from acid shale. Slope ranges from 1 to 5 percent.

Typical pedon of Crosstell fine sandy loam, 2 to 5 percent slopes, eroded; from the intersection of U.S. Highway 82 and Farm Road 901 in Sadler, 6.8 miles north on Farm Road 901, 2.1 miles east on county road, 0.2 mile north to wildlife refuge gate, 0.25 mile east on refuge road to 90 degree bend and 10 feet east of road, in pasture:

A1—0 to 3 inches; pale brown (10YR 6/3) fine sandy loam, brown (10YR 4/3) moist; moderate medium granular structure; hard, very friable; few fine roots; neutral; abrupt smooth boundary.

B21t—3 to 11 inches; red (2.5YR 4/6) clay, dark red (2.5YR 3/6) moist; many medium and coarse distinct reddish yellow (7.5YR 6/6) and yellowish red (5YR 5/6) mottles; moderate medium blocky structure; very hard, very firm; few fine roots; very strongly acid; clear smooth boundary.

B22t—11 to 22 inches; reddish yellow (7.5YR 6/6) clay, strong brown (7.5YR 5/6) moist; common fine and medium prominent red (2.5YR 4/6) mottles; moderate medium blocky structure; very hard, very firm; few fine roots; very strongly acid; gradual smooth boundary.

B23t—22 to 43 inches; mottled brownish yellow (10YR 6/6), red (2.5YR 4/6), and light gray (10YR 7/2) clay; moderate medium blocky structure; very hard, very firm; few fine roots; strongly acid; gradual smooth boundary.

C—43 to 60 inches; mottled reddish brown (2/5YR 4/4), yellowish brown (10YR 5/6), and light gray (10YR 7/2) moist shaly clay; massive; very hard, very firm; mildly alkaline.

The solum ranges from 40 to 60 inches in thickness.

The A horizon is brown, yellowish brown, pale brown, or light yellowish brown. It is medium acid through mildly alkaline. A thin A2 horizon that has value 1 or 2 units higher than the A1 horizon is in a few pedons.

The B2t horizon is reddish brown, reddish yellow, yellowish red, or red. This horizon has mottles of reddish brown, reddish yellow, yellowish red, red, yellow, brownish yellow, dark grayish brown, and light yellowish brown. It is strongly acid through moderately alkaline.

The C horizon is stratified clay, shale, and weakly cemented sandstone. It is neutral through moderately alkaline.

Eddy series

The Eddy series consists of very shallow and shallow, loamy soils. These soils formed in chalk. Slope ranges from 1 to 12 percent.

Typical pedon of Eddy gravelly clay loam, 5 to 12 percent slopes; from the intersection of U.S. Highway 69 and Texas Highway 11 in Whitewright, 0.6 mile west on Texas Highway 11, then 0.6 mile south, 0.7 mile west, and 1.3 miles south on county road and 30 feet east of road, in pasture:

A11—0 to 5 inches; light brownish gray (10YR 6/2) gravelly clay loam, dark grayish brown (10YR 4/2) moist; moderate medium granular structure; hard, firm; few fine roots; about 30 percent fine fragments of chalk; calcareous; moderately alkaline; gradual smooth boundary.

A12—5 to 13 inches; light brownish gray (10YR 6/2) very gravelly clay loam, dark grayish brown (10YR 4/2) moist; moderate medium granular structure; hard, firm; few fine roots; about 65 percent fragments of chalk as much as 5 inches across; calcareous; moderately alkaline; gradual wavy boundary.

Cr—13 to 16 inches; white (10YR 8/2) chalk, light gray (10YR 7/2) moist; platy in upper part of horizon and massive in lower part.

The solum ranges from 5 to 14 inches in thickness. Fragments of chalk make up more than 35 percent, by volume, of the solum.

The A horizon is light brownish gray, grayish brown, dark grayish brown, or brown. If this horizon is more than 4 inches thick, the moist color value is less than 3.5. The A horizon is gravelly clay loam or very gravelly clay loam in the upper part and very gravelly clay loam in the lower

part. It is 30 percent to 70 percent fragments of chalk that are dominantly less than 3 inches across, but range to as much as 7 inches.

The Cr horizon can be massive from its upper boundary downward, or it may be platy to a depth of about 2 feet. The chalk has a hardness of less than three on Mohs' scale.

Elbon series

The Elbon series consists of deep, clayey soils on bottom lands. These soils formed in recent alluvium. Slope ranges from 0 to 1 percent.

Typical pedon of Elbon clay, occasionally flooded; from the junction of Farm Roads 902 and 2729 in Tom Bean, 1.1 miles south on Farm Road 2729, 1.1 miles east on county road and 80 feet north, in woods:

A11—0 to 12 inches; dark grayish brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) moist; moderate medium granular and moderate fine subangular blocky structure; hard, firm; common fine and medium roots; calcareous; moderately alkaline; clear smooth boundary.

A12—12 to 23 inches; grayish brown (10YR 5/2) clay, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure; hard, firm; common fine roots; calcareous; moderately alkaline; gradual smooth boundary.

C1—23 to 43 inches; light brownish gray (10YR 6/2) clay, dark grayish brown (10YR 4/2) moist; weak medium subangular blocky structure; hard, firm; few fine roots; few films and threads of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.

C2—43 to 65 inches; gray (10YR 6/1) clay, dark grayish brown (10YR 4/2) moist; massive; hard, firm; few fine roots; common films and threads of calcium carbonate; calcareous; moderately alkaline.

The mollic epipedon ranges from 17 to 24 inches in thickness. Reaction is moderately alkaline. The soil is calcareous throughout.

The A horizon is dark grayish brown or grayish brown.

The C horizon is dark grayish brown, grayish brown, gray, or light brownish gray clay or silty clay loam.

Fairlie series

The Fairlie series consists of deep, clayey soils. These soils formed in chalk. Slope ranges from 0 to 5 percent.

Typical pedon of Fairlie clay, in an area of Fairlie and Houston Black clays, 1 to 3 percent slopes; from the intersection of Texas Highway 11 and Farm Road 697 at Sherman, 7.7 miles east on Farm Road 697 and 30 feet south of road, midway between a microknoll and a microdepression, in plowed field:

Ap—0 to 5 inches; very dark gray (10YR 3/1) clay, black (10YR 2/1) moist; moderate fine blocky and medium granular structure; very hard, very firm, sticky and plastic; few fine roots; few fine fragments of chalk; few shiny ped faces; few fine black concretions; few fine shell fragments; calcareous; moderately alkaline; abrupt smooth boundary.

A11—5 to 15 inches; very dark gray (10YR 3/1) clay, black (10YR 2/1) moist; moderate fine and medium blocky structure; very hard, very firm, sticky and plastic; few fine roots; few fine fragments of chalk; few fine shell fragments; few fine black concretions; calcareous; moderately alkaline; gradual wavy boundary.

A12—15 to 28 inches; dark grayish brown (2.5Y 4/2) clay, very dark grayish brown (2.5Y 3/2) moist; moderate fine and medium blocky structure; very hard, very firm, sticky and plastic; few fine roots; few fine and medium concretions of calcium carbonate; few black concretions; vertical streaks of black filling old cracks; intersecting slickensides; few shell fragments; calcareous; moderately alkaline; gradual wavy boundary.

AC—28 to 46 inches; grayish brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; few medium faint light olive brown (2.5Y 5/4) mottles; moderate fine and medium blocky structure; very hard, very firm; few fine roots; common fine and medium concretions of calcium carbonate; few black concretions; intersecting slickensides; calcareous; moderately alkaline; abrupt wavy boundary.

Cr—46 to 55 inches; white (10YR 8/1) chalk; massive.

The solum ranges from 40 to 60 inches in thickness. When dry, the soil has cracks 0.4 inch to 3 inches wide extending to a depth of more than 24 inches. Intersecting slickensides begin at a depth of about 16 inches. Areas that have not been tilled have gilgai microrelief, and the microknolls are 4 to 12 inches higher than the microdepressions. The distance from the center of the microknoll to the center of the microdepression ranges from 5 to 12 feet. Texture is silty clay or clay. Reaction is mildly alkaline or moderately alkaline, and most pedons are calcareous. Few to common concretions or soft masses of lime and chalk fragments, or both, are in most horizons.

The A horizon is dark gray, very dark gray, or dark grayish brown. To a depth of 12 inches this horizon has chroma of 1.5 or less in more than 60 percent of the pedon.

The AC horizon is dark gray, gray, dark grayish brown, or grayish brown. It has few to common mottles in shades of brown, yellow, gray, or olive. A thin C horizon of marly clay is above the Cr horizon in a few pedons. It is mainly in shades of gray, olive, and brown and commonly contains strata of weathered chalk.

The Cr horizon is light gray or white chalk that has hardness of less than three on Mohs' scale. Typically,

this horizon is platy in the upper few inches and is massive below.

Gasil series

The Gasil series consists of deep, sandy soils on uplands. These soils formed in loamy material interbedded with sandstone. Slope ranges from 1 to 8 percent.

Typical pedon of Gasil loamy fine sand, 1 to 5 percent slopes; from the intersection of Farm Road 901 and U.S. Highway 377 north of Whitesboro, 6.8 miles west and north on Farm Road 901, 0.85 mile east on county road and 100 feet south, in a field:

Ap—0 to 5 inches; brown (10YR 5/3) loamy fine sand, dark brown (10YR 3/3) moist; weak medium granular structure; loose, very friable; common fine roots; medium acid; abrupt smooth boundary.

A2—5 to 10 inches; yellowish brown (10YR 5/4) loamy fine sand, dark yellowish brown (10YR 4/4) moist; weak medium granular structure; loose, very friable; few fine roots; slightly acid; clear smooth boundary.

B21t—10 to 22 inches; strong brown (7.5YR 5/6) sandy clay loam, strong brown (7.5YR 5/6) moist; moderate medium subangular blocky structure; hard, friable; few fine roots; medium acid; gradual smooth boundary.

B22t—22 to 33 inches; brownish yellow (10YR 6/6) sandy clay loam, yellowish brown (10YR 5/6) moist; moderate medium subangular blocky structure; hard, friable; few fine roots; strongly acid; gradual smooth boundary.

B23t—33 to 45 inches; reddish yellow (7.5YR 6/6) sandy clay loam, strong brown (7.5YR 5/8) moist; few fine faint yellowish red mottles; moderate medium subangular blocky structure; hard, friable; few fine roots; strongly acid; gradual smooth boundary.

B24t—45 to 56 inches; brownish yellow (10YR 6/8) sandy clay loam; yellowish brown (10YR 5/8) moist; common coarse distinct red (2.5YR 4/6) mottles; weak medium subangular blocky structure; hard, friable; few fine roots; strongly acid; gradual smooth boundary.

B25t—56 to 66 inches; reddish yellow (7.5YR 6/6) sandy clay loam, strong brown (7.5YR 5/6) moist; common coarse prominent red (2.5YR 5/6) mottles; weak medium subangular blocky structure; hard, friable; few fine roots; few pockets of uncoated sand grains; strongly acid.

The solum ranges from 60 to more than 80 inches in thickness. Small fragments of sandstone and ironstone make up 0 to 5 percent, by volume, of the solum.

The A horizon is brown, dark yellowish brown, yellowish brown, pale brown, or light yellowish brown. It is fine sandy loam or loamy fine sand that is slightly acid through mildly alkaline. An A2 horizon 1 to 5 inches thick is in some pedons. If present, the A2 horizon is slightly lighter in color than the A1 horizon.

The Bt horizon is yellowish brown, brownish yellow, yellow, strong brown, or reddish yellow. The lower part of the Bt horizon has few to common contrasting mottles of strong brown, yellowish red, and red. This horizon is sandy clay loam or fine sandy loam and has 18 to 30 percent clay. It is strongly acid through slightly acid.

Heaton series

The Heaton series consists of deep, sandy soils on uplands. These soils formed in sandy and loamy material. Slope ranges from 1 to 5 percent.

Typical pedon of Heaton loamy fine sand, 1 to 5 percent slopes; from the intersection of Farm Roads 120 and 1753 at east edge of Denison, 0.9 mile southeast on Farm Road 1753, 0.6 mile south and 0.75 mile east on county road and 30 feet south, in idle pasture:

A1—0 to 8 inches; yellowish brown (10YR 5/4) loamy fine sand, dark yellowish brown (10YR 3/4) moist; weak medium granular structure; loose, very friable; common fine roots; neutral; clear smooth boundary.

A2—8 to 28 inches; light brown (7.5YR 6/4) loamy fine sand, brown (7.5YR 4/4) moist; weak medium granular structure; loose, very friable; few fine roots; neutral; clear smooth boundary.

B21t—28 to 41 inches; yellowish red (5YR 5/6) sandy clay loam, yellowish red (5YR 4/6) moist; moderate medium subangular blocky structure; hard, friable; few fine roots; medium acid; gradual smooth boundary.

B22t—41 to 53 inches; yellowish red (5YR 5/8) sandy clay loam, yellowish red (5YR 4/8) moist; moderate medium subangular blocky structure, hard, friable; few fine roots; medium acid; gradual smooth boundary.

B23t—53 to 65 inches; reddish yellow (7.5YR 6/6) sandy clay loam, strong brown (7.5YR 5/6) moist; weak medium subangular blocky structure; hard, friable; few fine roots; few black concretions; medium acid.

The solum ranges from 60 to more than 100 inches in thickness. It is medium acid through neutral throughout.

The A horizon is light yellowish brown, yellowish brown, brown, light brown, pink, very pale brown, or pale brown.

The Bt horizon is yellowish red, red, reddish brown, or reddish yellow. In some pedons this horizon has a few mottles in shades of brown and yellow.

Heiden series

The Heiden series consists of deep, clayey soils on uplands. These soils formed in clayey marine sediment. Slope ranges from 1 to 5 percent.

Typical pedon of Heiden clay, 1 to 3 percent slopes; from the intersection of U.S Highways 377 and 82 at Whitesboro, 2.7 miles east on U.S. Highway 82, 0.8 mile

north on county road, and 50 feet west in the center of a microknoll, in native grass meadow:

A11—0 to 5 inches; dark grayish brown (2.5Y 4/2) clay, very dark grayish brown (2.5Y 3/2) moist; moderate medium granular structure; very hard, very firm, sticky and plastic; many fine roots; few fine concretions of calcium carbonate; calcareous; moderately alkaline; clear wavy boundary.

A12—5 to 14 inches; dark grayish brown (2.5Y 4/2) clay, very dark grayish brown (2.5Y 3/2) moist; moderate medium granular and moderate fine blocky structure; very hard, very firm, sticky and plastic; common fine roots; few fine concretions of calcium carbonate; calcareous; moderately alkaline; gradual wavy boundary.

AC1—14 to 24 inches; olive (5Y 5/3) clay, olive (5Y 4/3) moist; moderate fine blocky structure; very hard, very firm, sticky and plastic; common fine roots; common fine concretions of calcium carbonate; calcareous; moderately alkaline; gradual wavy boundary.

AC2—24 to 40 inches; grayish brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; moderate fine blocky structure; very hard, very firm, sticky and plastic; few fine roots; common fine concretions of calcium carbonate; calcareous; moderately alkaline; gradual wavy boundary.

AC3—40 to 50 inches; grayish brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; few fine faint yellowish brown mottles; weak coarse blocky structure; very hard, very firm, sticky and plastic; few fine roots; few medium concretions of calcium carbonate; calcareous; moderately alkaline; gradual wavy boundary.

C—50 to 60 inches; mottled yellowish brown (10YR 5/6), gray (10YR 5/1), and light olive brown (2.5 5/4) moist shaly clay; massive; extremely hard, very firm, sticky and plastic; few fine roots; common fine and medium concretions of calcium carbonate; calcareous; moderately alkaline.

The solum ranges from 41 to 65 inches in thickness. The solum is thicker in microdepressions and thinner on microknolls. It is clay throughout.

The A horizon is dark grayish brown, grayish brown, very dark gray, dark gray, or olive.

The AC horizon is grayish brown, light yellowish brown, light olive brown, olive brown, yellowish brown, or olive. Mottles in the AC horizon range from none to common. The mottles are yellowish brown, dark yellowish brown, gray, light gray, dark grayish brown, or light olive brown. In some pedons this horizon has crystals of gypsum.

The C horizon has colors in shades of gray, brown, and yellow.

Houston Black series

The Houston Black series consists of deep, clayey soils. These soils formed in calcareous clays and marls. Slope ranges from 0 to 3 percent.

Typical pedon of Houston Black clay, in an area of Fairlie and Houston Black clays, 1 to 3 percent slopes; from the intersection of Farm Road 902 and U.S. Highway 75 in Howe, south 2.1 miles on east service road of U.S. Highway 75 and 35 feet east, in cropland:

Ap—0 to 5 inches; very dark gray (10YR 3/1) clay, black (10YR 2/1) moist; moderate fine blocky structure and moderate medium granular; very hard, very firm, sticky and plastic; common fine roots; few fine shell fragments; calcareous; moderately alkaline; abrupt smooth boundary.

A11—5 to 17 inches; very dark gray (10YR 3/1) clay, black (10YR 2/1) moist; moderate fine blocky structure; very hard, very firm, sticky and plastic; few fine roots; few fine shell fragments; few fine black concretions; calcareous; moderately alkaline; gradual wavy boundary.

A12—17 to 26 inches; dark grayish brown (2.5Y 4/2) clay, very dark grayish brown (2.5Y 3/2) moist; moderate fine blocky structure; very hard, very firm, sticky and plastic; few fine roots; few fine concretions of calcium carbonate; few fine shell fragments; few fine black concretions; few intersecting slickensides; calcareous; moderately alkaline; gradual wavy boundary.

AC1—26 to 41 inches; grayish brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; few fine faint light olive brown mottles; very hard, very firm; few fine roots; common fine and medium concretions of calcium carbonate; few soft masses of calcium carbonate; few black concretions; vertical streaks of black filling old cracks; intersecting slickensides; calcareous; moderately alkaline; gradual smooth boundary.

AC2—41 to 65 inches; light olive brown (2.5Y 5/4) clay, olive brown (2.5Y 4/4) moist; common medium faint olive yellow (2.5Y 6/6) mottles; weak coarse blocky structure; very hard, very firm; few fine roots; vertical streaks of black filling old cracks; common medium soft masses and concretions of calcium carbonate; few fine black concretions; intersecting slickensides; calcareous; moderately alkaline.

The solum ranges from 60 to more than 80 inches in thickness. When the soil is dry, it has cracks 0.4 inch to 3 inches wide extending to a depth of 20 inches or more. Intersecting slickensides begin at a depth of about 20 inches. Areas that have not been tilled have gilgai microrelief, and the microknolls are 4 to 12 inches higher than the microdepressions. The distance from the center of the microknoll to the center of the microdepression ranges from 5 to 12 feet. Texture is clay or silty clay.

Reaction is mildly alkaline or moderately alkaline, and most pedons are calcareous.

The A horizon is black, very dark gray, dark grayish brown or dark gray.

The AC horizon is dark gray, gray, dark grayish brown, light olive brown, grayish brown, or light brownish gray. Mottles in the AC horizon range from none to common. The mottles are dark gray, gray, dark grayish brown, light olive brown, grayish brown, light brownish gray, light gray, light yellowish brown, brownish yellow, or olive yellow.

Howe series

The Howe series consists of moderately deep, loamy soils. These soils formed in chalk. Slope ranges from 1 to 12 percent.

Typical pedon of Howe silty clay loam, 5 to 8 percent slopes; from the junction of U.S. Highway 82 and Texas Highway 11 in Sherman, southeast on Texas Highway 11 for 3.9 miles to Luella, west on paved county road for 0.1 mile, south on paved county road for 1.7 miles to gate at Holloway Cemetery and 25 feet east of right-of-way, in pasture:

A1—0 to 7 inches; grayish brown (10YR 5/2) silty clay loam, dark grayish brown (10YR 4/2) moist; moderate medium subangular blocky and fine granular structure; hard, firm; common fine and medium roots; common worm casts; few weakly cemented fragments of chalk less than 10 millimeters across; about 58 percent calcium carbonate equivalent; calcareous; moderately alkaline; gradual smooth boundary.

B21—7 to 15 inches; light gray (10YR 7/2) silty clay loam, light brownish gray (10YR 6/2) moist; moderate fine subangular blocky structure; hard, firm; common fine roots; common worm casts; few weakly cemented fragments of chalk less than 5 millimeters across; about 59 percent calcium carbonate equivalent; calcareous; moderately alkaline; gradual wavy boundary.

B22—15 to 26 inches; very pale brown (10YR 7/3) silty clay loam, pale brown (10YR 6/3) moist; moderate fine subangular blocky structure; hard, firm; few fine roots; about 27 percent weakly cemented, platy fragments of chalk that are slightly hard dry, but break down on wetting and gentle rubbing; about 62 percent calcium carbonate equivalent; few threads and films of calcium carbonate; calcareous; moderately alkaline; gradual wavy boundary.

Cr—26 to 32 inches; white (10YR 8/1) weakly cemented platy chalk; few thin seams of very pale brown silty clay loam in the upper part in vertical fractures and between plates of chalk; distinct horizontal bedding; calcareous; moderately alkaline.

The solum ranges from 20 to 40 inches in thickness. Calcium carbonate equivalent of the 10- to 40-inch control section ranges from 40 to about 80 percent. Texture is silty clay loam, silty clay, or clay loam. The total clay content is 30 to 45 percent, and silicate clay content is 25 to 35 percent.

The A horizon is dark grayish brown, grayish brown, brown, light brownish gray, or pale brown. Fragments of weakly cemented chalk in this horizon range from none to common.

The B horizon is grayish brown, light brownish gray, light gray, pale brown, very pale brown, light yellowish brown, or light olive brown. It is silty clay loam, clay loam, or silty clay. The lower part of the B horizon in some pedons has few to common yellow or brown mottles. In the upper part of the B horizon the content of chalk fragments ranges from 0 to about 20 percent, by volume, and in the lower part ranges from 5 to 35 percent. These fragments are hard to slightly hard when dry, but they slake if soaked overnight in Calgon and water. Platy fragments of calcite in the B horizon range from none to few.

The Cr horizon is white, light gray, very pale brown, or light brownish gray weakly cemented platy chalk and brittle marl. The upper few inches of this horizon has thin seams of yellowish brown, brownish yellow, very pale brown, or pale yellow silty clay loam in fractures and between plates of chalk. The Cr horizon becomes more massive and less fractured as depth increases. It is slightly hard to hard when dry but is easily cut with a spade when moist. It has hardness of less than two on Mohs' scale.

Kiomatia series

The Kiomatia series consists of deep, sandy soils. These soils formed in sandy alluvium. Slope ranges from 0 to 2 percent.

Typical pedon of Kiomatia loamy fine sand, in an area of Oklared-Kiomatia complex, occasionally flooded; from the junction of Farm Roads 120 and 1753 east of Denison, 2.6 miles east on Farm Road 120, 0.2 mile north on county road, 2.0 miles north on gravel pit road to pit headquarters and 1,200 feet west to small sand pit:

A1—0 to 7 inches; light brown (7.5YR 6/4) loamy fine sand, brown (7.5YR 5/4) moist; weak medium granular structure; loose, very friable; calcareous; moderately alkaline; clear smooth boundary.

C1—7 to 20 inches; light brown (7.5YR 6/4) fine sand, brown (7.5YR 5/4) moist; single grain; loose, very friable; many very thin strata of loam and silt loam; calcareous; moderately alkaline; gradual smooth boundary.

C2—20 to 35 inches; light brown (7.5YR 6/4) very fine sand, brown (7.5YR 5/4) moist; single grain; loose, very friable; many thin and medium strata of loam and silt loam; calcareous; moderately alkaline; gradual smooth boundary.

C3—35 to 56 inches; pink (7.5YR 7/4) very fine sand, light brown (7.5YR 6/4) moist; single grain; loose,

very friable; many thin strata of loam and silt loam; calcareous; moderately alkaline; gradual smooth boundary.

C4—56 to 80 inches; pink (7.5YR 7/4) very fine sand, light brown (7.5YR 6/4) moist; single grain; loose, very friable; many medium strata of fine sandy loam and silt loam; calcareous; moderately alkaline.

The A horizon is brown, strong brown, light brown, pink, or light reddish brown.

The C horizon is very fine sand, fine sand, or loamy fine sand and contains many thin strata of loam and silt loam. It is reddish brown, light reddish brown, pink, light brown, or strong brown.

Konsil series

The Konsil series consists of deep, loamy and sandy soils on uplands. These soils formed in loamy material and the interbedded sandstone. Slope ranges from 1 to 8 percent.

Typical pedon of Konsil fine sandy loam, 2 to 5 percent slopes; from the intersection of Farm Roads 996 and 120 in Pottsboro, 4.6 miles northwest on Farm Road 996, 0.9 mile north to the end of Farm Road 996, 1.4 miles west and 1.3 miles south and west on county road, 0.8 mile northwest on Corps of Engineers Road to campground at Paradise Cove, and 140 feet west to edge of woods:

A—0 to 9 inches; brown (7.5YR 5/4) fine sandy loam, dark brown (7.5YR 4/4) moist; moderate medium granular structure; hard, very friable; common roots; neutral; clear smooth boundary.

B21t—9 to 23 inches; yellowish red (5YR 5/6) sandy clay loam, reddish brown (5YR 4/4) moist; moderate medium subangular blocky structure; hard, friable; common roots; few clay films; slightly acid; gradual smooth boundary.

B22t—23 to 35 inches; yellowish red (5YR 5/6) sandy clay loam, yellowish red (5YR 4/6) moist; few fine faint reddish brown mottles; moderate medium subangular blocky structure; hard, friable; few roots; few clay films; slightly acid; gradual smooth boundary.

B23t—35 to 56 inches; yellowish red (5YR 5/6) sandy clay loam, yellowish red (5YR 4/6) moist; few medium faint strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; hard, friable; few fine roots; few clay films; medium acid; gradual smooth boundary.

B24t—56 to 65 inches; reddish yellow (7.5YR 6/6) sandy clay loam, strong brown (7.5YR 5/6) moist; few fine roots; weak medium subangular blocky structure; hard, friable; medium acid.

The solum ranges from 60 to more than 80 inches in thickness. Fragments of sandstone and ironstone throughout the pedon range from none to about 3 percent by volume.

The A horizon is brown, light brown, dark reddish gray, or reddish brown. It is slightly acid or neutral fine sandy loam or loamy fine sand. An A2 horizon, 3 to 8 inches thick, is in some profiles. It is slightly lighter in color than the A1 horizon.

The Bt horizon is yellowish red, reddish brown, reddish yellow, light red, or red. Mottles in the lower part of this horizon range from none to common. The mottles are red, yellowish red, reddish yellow, and strong brown. The Bt horizon is dominantly sandy clay loam but ranges to fine sandy loam in the lower part. It is strongly acid through slightly acid.

Lewisville series

The Lewisville series consists of deep, clayey soils on terraces, that formed in calcareous, loamy alluvial sediments. Slope ranges from 1 to 5 percent.

Typical pedon of Lewisville silty clay, 1 to 3 percent slopes; from the intersection of Farm Road 2729 and Texas Highway 11 in Tom Bean, 1.1 miles north on Farm Road 2729 and 1,600 feet west, in bermudagrass pasture:

A1—0 to 19 inches; dark grayish brown (10YR 4/2) silty clay, very dark grayish brown (10YR 3/2) moist; moderate fine subangular blocky structure; hard, friable; common fine roots; few concretions of calcium; calcareous; moderately alkaline; gradual smooth boundary.

B21ca—19 to 38 inches; grayish brown (10YR 5/2) silty clay, dark grayish brown (10YR 4/2) moist; moderate fine subangular blocky structure; hard, friable; few fine roots; few fine shell fragments; few threads and films of calcium cabonate; calcareous; moderately alkaline; diffuse boundary.

B22ca—38 to 75 inches; very pale brown (10YR 7/3) silty clay, pale brown (10YR 6/3) moist; weak fine subangular blocky structure; hard, firm; few fine roots; common soft masses of calcium carbonate; calcareous; moderately alkaline.

The solum ranges from 48 to more than 70 inches in thickness. It is moderately alkaline and calcareous throughout.

The A horizon is brown, very dark grayish brown, or dark grayish brown.

The B21ca horizon is grayish brown, light brownish gray, yellowish brown, or light yellowish brown. It is clay loam, silty clay loam, or silty clay. The B22ca horizon is brown, pale brown, very pale brown, light yellowish brown, or light brown. It is clay loam, silty clay loam, or silty clay. The Bca horizon has 5 to 15 percent soft masses, films, threads, and concretions of calcium carbonate.

Lindy series

The Lindy series consists of moderately deep, loamy soils on uplands. These soils formed in material weathered from thick beds of limestone. Slope ranges from 1 to 3 percent.

Typical pedon of Lindy loam, 1 to 3 percent slopes; from the junction of Farm Road 1310 and Texas Highway 75A at Denison Dam, 1.8 miles west on Farm Road 1310, 0.15 mile south on county road and 20 feet east of right-of-way, in range:

A1—0 to 8 inches; dark brown (7.5YR 4/2) loam, dark brown (7.5YR 3/2) moist; moderate medium subangular blocky structure; hard, friable; few fine roots; neutral; clear smooth boundary.

B21t—8 to 18 inches; reddish brown (5YR 4/4) clay, dark reddish brown (5YR 3/4) moist; moderate fine subangular blocky structure; hard, firm; few fine roots; mildly alkaline; clear smooth boundary.

B22t—18 to 31 inches; reddish brown (5YR 4/4) clay, reddish brown (5YR 4/4) moist; moderate fine subangular blocky structure; hard, firm; few fine roots; few fine black concretions; mildly alkaline; abrupt wavy boundary.

R—31 inches; hard, fractured limestone.

The solum ranges from 20 to 40 inches in thickness.

The A horizon is dark grayish brown, dark brown, brown, or reddish brown. It is slightly acid through mildly alkaline. This horizon has 0 to 10 percent coarse fragments.

The Bt horizon is reddish brown or brown clay loam or clay. It is slightly acid through mildly alkaline. This horizon has 0 to 15 percent gravel.

The R layer is hard, slightly fractured limestone.

Mabank series

The Mabank series consists of deep, loamy soils. These soils formed in ancient alluvium. Slope ranges from 0 to 3 percent.

Typical pedon of Mabank loam, 0 to 1 percent slopes; from the intersection of U.S. Highways 82 and 377 in Whitesboro, 3.2 miles south on U.S. Highway 377, 0.1 mile east and 0.6 mile south on county road and 62 feet east of right-of-way, in bermudagrass pasture:

Ap—0 to 4 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; hard, friable; many fine roots; medium acid; abrupt smooth boundary.

A1—4 to 8 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; hard, friable; many fine roots; medium acid; abrupt wavy boundary.

B21tg—8 to 25 inches; dark gray (10YR 4/1) clay, very dark gray (10YR 3/1) moist; strong medium blocky structure; extremely hard, very firm; few fine roots; few fine black concretions; few fine slickensides; few vertical streaks of loamy material from the A horizon; mildly alkaline; gradual smooth boundary.

B22tg—25 to 37 inches; dark gray (10YR 4/1) clay, very dark gray (10YR 3/1) moist; moderate medium blocky structure; extremely hard, very firm; few fine roots; few fine slickensides; few vertical streaks of loamy material from the A horizon; moderately alkaline; gradual smooth boundary.

B23tg—37 to 58 inches; gray (10YR 5/1) clay, dark gray (10YR 4/1) moist; moderate medium blocky structure; extremely hard, very firm; few fine roots; few fine slickensides; vertical streaks of loamy material; moderately alkaline; gradual smooth boundary.

B3—58 to 80 inches; light gray (10YR 6/1) clay; common coarse distinct brownish yellow (10YR 6/8) mottles; weak coarse blocky structure; extremely hard, very firm; few fine root; few fine black concretions; common crystals of gypsum; slightly acid.

The solum ranges from 60 to more than 80 inches in thickness. Each year during dry periods this soil has cracks as much as 0.4 inch wide extending to a depth of 20 inches of more.

The A horizon is grayish brown or dark grayish brown. It is medium acid through neutral. This horizon is hard or very hard and massive when dry.

The B21tg horizon is dark gray or very dark gray. It is neutral through moderately alkaline. It has a few mottles of yellowish brown, olive brown, or grayish brown in some pedons. The lower part of the B2t horizon and the B3 horizon are grayish brown, light brownish gray, light gray, or gray. They are medium acid through moderately alkaline. These horizons have mottles of olive brown, yellowish brown, light yellowish brown, or brownish yellow in most pedons. In most pedons there are a few small slickensides.

Normangee series

The Normangee series consists of deep, loamy soils on uplands. These soils formed in alkaline marine sediment of shale and clay. Slope ranges from 1 to 8 percent.

Typical pedon of Normangee clay loam, 1 to 4 percent slopes; from the intersection of Texas Highway 56 and U.S. Highway 377 in Whitesboro, 1.8 miles east on Texas Highway 56, 2.1 miles south on Farm Road 901, 200 feet east on oilfield road and 100 feet north, in pasture:

A1—0 to 7 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; hard, friable; common fine and medium roots; few fine black concretions; medium acid; clear wavy boundary.

B2lt—7 to 15 inches; brown (10YR 5/3) clay, dark brown (10YR 4/3) moist; common medium prominent red-

dish brown (2.5YR 4/4) mottles; moderate medium blocky structure; extremely hard, very firm; common fine roots; few fine black concretions; few dark brown vertical streaks; medium acid; gradual smooth boundary.

B22t—15 to 34 inches; grayish brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; common medium prominent red (2.5YR 4/6) and common medium faint yellowish brown (10YR 5/4) mottles; moderate medium blocky structure; extremely hard, very firm; few fine roots; few medium black concretions; few dark brown vertical streaks; medium acid; gradual smooth boundary.

B23t—34 to 45 inches; light yellowish brown (2.5Y 6/4) clay, light olive brown (2.5Y 5/4) moist; common medium distinct gray (10YR 5/1) mottles; moderate medium blocky structure; extremely hard, very firm; few fine roots; few fine pores; few very small siliceous pebbles; few dark brown vertical streaks; few small pressure faces; medium acid; gradual smooth boundary.

B24t—45 to 55 inches; light olive brown (2.5Y 5/4) clay, olive brown (2.5Y 4/4) moist; common medium distinct gray (10YR 5/1) mottles; weak medium blocky structure; extremely hard, very firm; few fine roots; few medium and large black concretions; few small siliceous pebbles; moderately alkaline; gradual smooth boundary.

C—55 to 65 inches; mottled olive yellow (2.5Y 6/6) and grayish brown (2.5Y 5/2) shaly clay; massive; very hard, very firm; few fine roots in upper part; few concretions of calcium carbonate; few fine and medium black concretions; moderately alkaline.

The solum ranges from 40 to 60 inches in thickness. Depth to visible carbonates is more than 28 inches.

The A horizon is dark grayish brown or dark brown. It is medium acid through neutral.

The B21t horizon is brown, reddish brown, or yellowish brown. It has few to common mottles in shades of brown, red, and yellow. Below the B21t horizon, the B2t horizon has colors in shades of brown and olive and has yellowish, reddish, or brownish mottles. The B2t horizon is medium acid through moderately alkaline.

The C horizon has color in shades of gray, yellow, or brown. It is shaly clay or weathered shale. This horizon is mildly alkaline or moderately alkaline. In some pedons it is weakly calcareous.

Okay series

The Okay series consists of deep, loamy soils on the terraces of major streams and rivers. These soils formed in alluvium. Slope ranges from 0 to 1 percent.

Typical pedon of Okay fine sandy loam, 0 to 1 percent slopes; from the intersection of Farm Roads 1897 and 1753 in Ambrose, 0.75 mile west on Farm Road 1753, 0.6 mile north on paved county road, 0.6 mile east on unpaved county road and 30 feet south of right-of-way, in old abandoned field:

Ap—0 to 7 inches; brown (10YR 5/3) fine sandy loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; hard, very friable; common fine roots; mildly alkaline; abrupt smooth boundary.

A1—7 to 12 inches; brown (10YR 5/3) fine sandy loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; hard, very friable; common fine roots; mildly alkaline; clear smooth boundary.

B21t—12 to 21 inches; brown (7.5YR 5/4) sandy clay loam, dark brown (7.5YR 4/4) moist; fine and medium subangular blocky structure; hard, friable; few fine roots; few patchy clay films; medium acid; gradual smooth boundary.

B22t—21 to 32 inches; light brown (7.5YR 6/4) sandy clay loam, brown (7.5YR 5/4) moist; moderate medium subangular blocky structure; hard, friable; few fine roots; medium acid; gradual smooth boundary.

B23t—32 to 44 inches; reddish yellow (7.5YR 6/6) sandy clay loam, strong brown (7.5YR 5/6) moist; moderate medium subangular blocky structure; hard, friable; few fine roots; medium acid; gradual smooth boundary.

B3—44 to 65 inches; reddish yellow (7.5YR 6/6) sandy clay loam, strong brown (7.5YR 5/6) moist; weak medium subangular blocky structure; hard, friable; few fine roots; few small siliceous pebbles; medium acid.

The solum is more than 60 inches thick.

The A horizon is brown, grayish brown, or dark grayish brown. It is slightly acid through mildly alkaline.

The Bt horizon is brown, dark brown, light brown, or reddish yellow. It is medium acid or slightly acid.

The B3 horizon is reddish yellow or brownish yellow sandy clay loam or fine sandy loam. In some pedons this horizon has a few yellowish red mottles in the lower part. It is medium acid or slightly acid.

The Okay soils in Grayson County are taxadjuncts to the Okay series. They are slightly more alkaline in the A horizon than is defined in the range for the series. However, the uses, management, and behavior of these soils are the same as that of the Okay series.

Oklared series

The Oklared series consists of deep, loamy soils on flood plains. These soils formed in alluvium. Slope is 0 to 1 percent.

Typical pedon of Oklared very fine sandy loam; from the intersection of Farm Roads 120 and 1753 in east edge of Denison, 5.3 miles east on Farm Road 120, 0.8 mile north, 0.3 mile west, and 0.25 mile north on field road and 30 feet west, in pasture:

Ap—0 to 7 inches; brown (7.5YR 5/4) very fine sandy loam, dark brown (7.5YR 4/4) moist; moderate medium granular structure; hard, very friable; common fine and medium roots; few worm casts; calcareous; moderately alkaline; gradual smooth boundary.

C1—7 to 11 inches; light reddish brown (5YR 6/4) very fine sandy loam, reddish brown (5YR 5/4) moist; moderate medium granular structure; hard, very friable; common fine roots; few worm casts; calcareous; moderately alkaline; clear smooth boundary.

C2—11 to 19 inches; reddish brown (5YR 5/3) loam, dark reddish brown (5YR 3/3) moist; moderate medium granular structure; hard, very friable; common fine roots; few worm casts; calcareous in spots; moderately alkaline; gradual smooth boundary.

C3—19 to 30 inches; reddish brown (5YR 5/3) fine sandy loam, dark reddish brown (5YR 3/3) moist; moderate medium granular structure; hard, very friable; few fine roots; calcareous in spots; moderately alkaline; gradual smooth boundary.

C4—30 to 50 inches; reddish brown (5YR 5/4) fine sandy loam, dark reddish brown (5YR 3/4) moist; moderate medium granular structure; hard, very friable; few fine roots; calcareous in spots; moderately alkaline; diffuse smooth boundary.

C5—50 to 74 inches; yellowish red (5YR 5/6) loamy fine sand, yellowish red (5YR 4/6) moist; single grain; loose, very friable; calcareous in spots; moderately alkaline.

The A horizon is 5 to 15 inches thick. It is dark brown, brown, strong brown, dark reddish brown, or reddish brown. This horizon is mildly alkaline or moderately alkaline and is calcareous.

The C horizon is yellowish red, reddish yellow, reddish brown, light reddish brown, pink, or strong brown. It is dominantly fine sandy loam or very fine sandy loam but has many thin strata of finer and coarser materials (fig 14). This horizon is mildly alkaline or moderately alkaline and is calcareous.

Figure 14.—Profile of Oklared very fine sandy loam showing stratification below a depth of about 36 inches.

Purves series

The Purves series consists of shallow, loamy soils on uplands. These soils formed in material weathered from interbedded hard limestone and calcareous marl. Slope ranges from 1 to 5 percent.

Typical pedon of Purves clay loam, 1 to 5 percent slopes; from the junction of Farm Roads 1417 and 120 west of Denison, west 0.2 mile on Farm Road 120, north 2.4 miles and 0.4 mile west on county road and 20 feet south, in range:

A11—0 to 8 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure; hard, friable; common fine roots; few pebbles of limestone and ironstone; calcareous; moderately alkaline; clear wavy boundary.

A12—8 to 14 inches; brown (10YR 4/3) clay loam, dark brown (10YR 3/3) moist; moderate medium subangular blocky structure; hard, friable; common fine roots; about 10 percent small fragments of limestone and ironstone; calcareous; moderately alkaline; abrupt wavy boundary.

R—14 inches; hard, slightly fractured limestone with soil in fractures.

The solum ranges from 13 to 17 inches in thickness. Fragments of limestone range from 0 to 35 percent.

The A horizon is very dark gray, dark gray, grayish brown, dark grayish brown, very dark grayish brown, or brown.

The Purves soils in Grayson County are taxadjuncts to the Purves series because they do not have sufficient secondary calcium carbonate coatings on the fragments of limestone to have a calcic horizon. Also, they are in a climate that is slightly more moist than is typical for the Purves series. These soils are calcareous throughout, however, and have the same use and management as the Purves series.

Redlake series

The Redlake series consists of deep, clayey soils on flood plains. These soils formed in recent alluvium. Slope is 0 to 1 percent.

Typical pedon of Redlake clay, occasionally flooded; from the intersection of Farm Roads 1753 and 120 in Denison, 5.8 miles east on Farm Road 120 to Carpenters Bluff, 2.3 miles south on paved county road and 65 feet southwest, in bermudagrass pasture:

A1—0 to 8 inches; weak red (2.5YR 4/2) clay, dusky red (2.5YR 3/2) moist; moderate medium blocky structure; very hard, very firm; many fine roots; few fine shell fragments; calcareous; moderately alkaline; clear smooth boundary.

B2—8 to 37 inches; reddish brown (2.5YR 4/4) clay, dark reddish brown (2.5YR 3/4) moist; moderate medium blocky structure; hard, firm; few fine roots; few fine shell fragments; few concretions of calcium carbonate; calcareous; moderately alkaline; clear wavy boundary.

C—37 to 60 inches; reddish brown (2.5YR 4/4) clay, dark reddish brown (2.5YR 3/4) moist; massive; hard, firm; few fine roots; few thin strata of dark grayish brown (2.5Y 4/2) silt loam; few fine shell fragments; few concretions of calcium carbonate; few bedding planes; calcareous; moderately alkaline.

The solum ranges from 30 to 55 inches in thickness. It is calcareous and moderately alkaline throughout.

The A horizon is dusky red, weak red, dark reddish brown, reddish brown, or dark reddish gray.

The B horizon is dark reddish brown, reddish brown, dark red, or red clay or silty clay. This horizon has slickensides in some pedons, but they do not intersect.

The C horizon is clay, stratified with thin layers of silt loam, loam, and clay loam. It is in shades of red and brown.

Sanger series

The Sanger series consists of deep, clayey soils on uplands. These soils formed in alkaline marine sediment. Slope ranges from 1 to 8 percent.

Typical pedon of Sanger clay, 3 to 5 percent slopes; from the intersection of Texas Highway 75A and Farm Road 84 in Denison, 7.4 miles northwest on Farm Road 84, 0.4 mile east and 300 feet north on county road and 400 feet east of right-of-way, in johnsongrass pasture:

A11—0 to 7 inches; very dark gray (10YR 3/1) clay, black (10YR 2/1) moist; moderate medium blocky structure; very hard, very firm; common fine and medium roots; few fine fragments of limestone; calcareous; moderately alkaline; clear wavy boundary.

A12—7 to 23 inches; dark grayish brown (2.5Y 4/2) clay, very dark grayish brown (2.5Y 3/2) moist; moderate coarse blocky structure; very hard, very firm; common fine roots; few fine shell fragments; few intersecting slickensides; many medium concretions of calcium carbonate; calcareous; moderately alkaline; gradual wavy boundary.

AC1—23 to 34 inches; olive (5Y 5/3) clay, olive (5Y 4/3) moist; few medium faint olive brown (2.5Y 4/4) mottles; weak coarse blocky structure; very hard, very firm; common fine roots; common medium and large concretions of calcium carbonate; common intersecting slickensides; calcareous; moderately alkaline; gradual wavy boundary.

AC2—34 to 49 inches; olive (5Y 5/3) clay, olive (5Y 4/3) moist; common coarse distinct pale olive (5Y 6/4) mottles; weak coarse blocky structure; very hard, very firm; few fine roots; common concretions of calcium carbonate; intersecting slickensides; few black concretions and streaks; calcareous; moderately alkaline; gradual wavy boundary.

C—49 to 65 inches; mottled brownish yellow (10YR 6/6) and light gray (10YR 7/1) shaly clay; massive; extremely hard, extremely firm; few fine roots; calcareous; moderately alkaline.

The solum ranges from 40 to 60 inches in thickness. When the soil is dry, it has cracks much as 1 inch wide extending to a depth of 20 inches or more. Intersecting slickensides begin at a depth of 16 to 24 inches. Reaction is moderately alkaline. The soil is calcareous. Areas that have not been tilled have gilgai microrelief that extends up and down the slopes. The microrelief consists of microknolls 6 to 20 feet wide and microdepressions 3 to 12 feet wide. The microknolls are 3 to 12 inches higher than the microdepressions.

The A horizon is very dark gray, very dark grayish brown, dark gray, or dark grayish brown. In some pedons, the A11 horizon has 2 to 15 percent coarse fragments of limestone. These fragments range from 2 to 6 inches thick and 2 to 6 feet across the long axis. They are tilted at about a 60 degree angle and extend from about 2 to 26 inches above the surface.

The AC1 horizon is grayish brown, light brownish gray, light yellowish brown, olive, or light olive brown. Mottles range from none to few in this horizon and are brownish yellow, olive yellow, or yellow.

The AC2 horizon is grayish brown, light brownish gray, olive, or light yellowish brown. Mottles range from none to common in this horizon. They are gray, yellowish brown, or light olive brown.

The C horizon is mottled gray, light olive brown, gray, olive brown, very dark gray, light gray, and brownish yellow. It is clay or silty clay.

Speck Variant

The Speck Variant consists of shallow, loamy soils on uplands. These soils formed in chalk. Slope ranges from 1 to 3 percent.

Typical pedon of Speck Variant loam, 1 to 3 percent slopes; from the intersection of Texas Highway 289 and Farm Road 902 at Dorchester, 2.6 miles south on Texas Highway 289, and 1.3 miles east on county road and 20 feet north, in a field:

Ap—0 to 5 inches; reddish brown (5YR 4/3) loam, dark reddish brown (5YR 3/3) moist; moderate medium granular structure; hard, firm; few fine roots; few fragments of chalk; moderately alkaline; abrupt smooth boundary.

B2t—5 to 15 inches; reddish brown (5YR 4/3) clay, dark reddish brown (5YR 3/3) moist; moderate fine blocky structure; hard, firm; few fine roots; mildly alkaline; abrupt wavy boundary.

R—15 to 18 inches; white (10YR 8/1) chalk; platy in the upper 3 inches, massive below.

The solum ranges from 14 to 20 inches in thickness. Reaction is neutral through moderately alkaline. Fragments of chalk on the surface range from 0 to 15 percent.

The A horizon is reddish brown or dark reddish gray.

The Bt horizon is reddish brown or dark reddish brown.

The R layer is white or light gray chalk that has hardness of about three on Mohs' scale.

The Speck soils in Grayson County are variants of the Speck series. They are in a climate that is more moist than is typical for the Speck series. They have a contact with white Austin Chalk of Upper Cretaceous age. The chalky limestone has a hardness of about three on Mohs' scale, but is rippable. In addition, crop yields are higher than on soils in the Speck series.

Stephen series

The Stephen series consists of shallow, clayey soils on uplands. These soils formed in chalk. Slope ranges from 1 to 5 percent.

Typical pedon of Stephen silty clay, 1 to 3 percent slopes; from the intersection of U.S. Highway 75 and Farm Road 121 in Van Alstyne, 4.2 miles east on Farm Road 121, 0.9 mile south and 0.9 mile east on county road and 150 feet south of road, in idle cropland:

A1—0 to 13 inches; very dark grayish brown (10YR 3/2) silty clay, very dark brown (10YR 2/2) moist; moderate medium subangular blocky structure; hard, firm; common fine roots; about 2 percent fine fragments of chalk; calcareous; moderately alkaline; clear wavy boundary.

C&A—13 to 18 inches; grayish brown (10YR 5/2) very gravelly silty clay, very dark grayish brown (10YR 3/2) moist; moderate fine granular and subangular blocky structure; hard, friable; few fine roots; about 60 percent weakly cemented fragments of chalk 0.5 inch to 3 inches long; calcareous; moderately alkaline; abrupt smooth boundary.

Cr—18 to 23 inches; fractured, white platy chalk.

The solum ranges from 11 to 20 inches in thickness.

The A horizon is brown, dark brown, grayish brown, dark grayish brown, or very dark grayish brown. It has 2 to about 20 percent, by volume, fragments of chalk.

The C&A horizon is 50 to 90 percent weakly cemented fragments of chalk.

The Cr horizon is platy chalk that grades to massive and has hardness of less than 3 on Mohs' scale. This horizon is white or light gray and has streaks of yellow.

Trinity series

The Trinity series consists of deep, clayey soils on flood plains. These soils formed in alluvium. Slope is 0 to 1 percent.

Typical pedon of Trinity clay, occasionally flooded; from the intersection of Farm Roads 1753 and 120 in east edge of Denison, 4.1 miles southeast on Farm Road 1753, 1.1 miles south along pipeline and 25 feet east, in a field:

Ap—0 to 7 inches; very dark gray (10YR 3/1) clay, black (10YR 2/1) moist; moderate fine and very fine subangular blocky structure; very hard, very firm; common fine roots; common vertical cracks; calcareous; moderately alkaline; abrupt smooth boundary.

A11—7 to 36 inches; very dark gray (10YR 3/1) clay, black (10YR 2/1) moist; moderate medium blocky structure; very hard, very firm; common fine roots; common vertical cracks; few intersecting slickensides below depth of 16 inches; calcareous; moderately alkaline; gradual wavy boundary.

A12—36 to 52 inches; dark gray (5Y 4/1) clay, very dark gray (5Y 3/1) moist; moderate medium blocky structure; very hard, very firm; few fine roots; common intersecting grooved slickensides; few soft masses of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.

C—52 to 65 inches; mottled light olive brown (2.5Y 5/4), olive brown (2.5Y 4/4), and dark grayish brown (2.5Y 4/2) clay; moderate medium blocky structure; very hard, very firm; few fine roots; few soft masses of calcium carbonate; few medium concretions of calcium carbonate; calcareous; moderately alkaline.

This soil is mildly alkaline or moderately alkaline throughout. Areas that have not been tilled have gilgai microrelief.

The A horizon is very dark gray, dark gray, or black. It has slickensides below a depth of 16 inches.

The C horizon is mottled in shades of brown and gray. Strongly cemented concretions of calcium carbonate range from none to many in the C horizon.

Vertel series

The Vertel series consists of moderately deep, clayey soils on uplands. These soils formed in material weathered from clayey shale. Slope ranges from 1 to 12 percent.

Typical pedon of Vertel clay, 3 to 5 percent slopes; from the headquarters of Hagerman National Wildlife Refuge, 0.5 mile north and 0.8 mile southwest on country road, 0.8 mile east on Refuge Road, 0.3 mile north on oilfield road and 20 feet south between a microknoll and a microdepression, in pasture:

A1—0 to 5 inches; grayish brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; moderate fine blocky structure; extremely hard, very firm, very sticky and plastic; few fine roots; common vertical cracks 0.5 inch to 1.5 inches wide; mildly alkaline; clear wavy boundary.

AC—5 to 33 inches; olive (5Y 5/3) clay, olive (5Y 4/3) moist; few coarse distinct yellowish brown (10YR 5/6) mottles; moderate medium blocky structure; extremely hard, very firm, very sticky and plastic; few fine roots; common vertical cracks 0.5 inch wide; common intersecting slickensides and wedge-shaped parallelepipeds below depth of 15 inches; few medium and fine concretions of calcium carbonate; common angular crystals of gypsum; moderately alkaline; gradual wavy boundary.

Cr—33 to 54 inches; stratified light olive brown (2.5Y 5/4) and gray (5Y 6/1) very shaly clay; massive; extremely hard, very firm; few crystals of gypsum; moderately alkaline; gradual wavy boundary.

The solum ranges from 24 to 40 inches in thickness. When this soil is dry, it has cracks 0.5 inch to 1.5 inches wide extending to the Cr horizon. Areas that have not been tilled have gilgai microrelief that extends up and down the slope. The microrelief consists of microdepressions 1 to 3 feet wide and 2 to 8 inches deep and microknolls 10 to 16 feet wide.

The A horizon is dark grayish brown, grayish brown, or olive. It is neutral through moderately alkaline and is noncalcareous in more than half of the pedons.

The AC horizon is dark grayish brown, grayish brown, light brownish gray, olive, light olive brown, light yellowish brown, or olive gray. Mottles range from none to common in the AC horizon. The mottles are olive, olive gray, light olive brown, gray, and yellowish brown. This horizon is neutral through moderately alkaline. It is 60 to 76 percent clay, and it has few to common gypsum crystals. In some pedons, this horizon has a few strongly cemented concretions of calcium carbonate.

The Cr horizon is stratified gray, yellowish brown, or olive brown very shaly clay. It is slightly acid through moderately alkaline. Gypsum crystals in this horizon range from none to common.

Whitesboro series

The Whitesboro series consists of deep, loamy soils on flood plains. These soils formed in alluvium. Slope is dominantly less than 1 percent.

Typical pedon of Whitesboro loam, occasionally flooded; from the intersection of U.S. Highway 82 and Farm Road 901 in south edge of Sadler, 1.1 miles north on Farm Road 901, 0.9 mile east and north on unpaved county road, 0.2 mile north on field road and 0.1 mile east, in pasture:

A11—0 to 19 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; hard, friable; many fine roots; few fine pores; neutral; gradual smooth boundary.

A12—19 to 27 inches; dark grayish brown (10YR 4/2) sandy clay loam, very dark grayish brown (10YR 3/2) moist; few medium faint gray (10YR 5/1) and common fine distinct reddish brown mottles; moderate medium subangular blocky structure; hard, firm; common fine roots; common fine pores; slightly acid; gradual smooth boundary.

B21—27 to 39 inches; brown (7.5YR 5/4) clay loam, dark brown (7.5YR 4/4) moist; many medium distinct reddish brown (5YR 4/4) and common medium distinct gray (10YR 5/1) mottles; moderate medium subangular blocky structure; hard, firm; few fine roots; common fine pores; slightly acid; gradual smooth boundary.

B22—39 to 72 inches; mottled gray (10YR 6/1) and reddish yellow (7.5YR 6/6) sandy clay loam; weak medium subangular blocky structure; hard, firm; few fine roots; common fine black concretions; moderately alkaline.

The solum ranges from 40 to more than 60 inches in thickness. The mollic epipedon ranges from 20 to about 50 inches in thickness. The average texture of the 10- to 40-inch control section is clay loam, loam, or sandy clay loam, and the content of clay ranges from 22 to 35 percent. Few to common mottles in shades of gray or brown are within a depth of 40 inches.

The A horizon is black, very dark brown, dark brown, very dark grayish brown, dark grayish brown, very dark gray, or dark gray. It is slightly acid through mildly alkaline.

The B horizon is dark gray, gray, grayish brown, dark grayish brown, brown, yellowish brown, or dark yellowish brown. This horizon has few to many mottles in shades of brown, gray, red, or yellow, and in some pedons it has matrix mottled in these colors. The upper part of the B horizon is slightly acid through mildly alkaline, and the lower part is neutral through moderately alkaline.

Whitewright series

The Whitewright series consists of shallow, loamy soils on uplands. These soils formed in soft, platy chalk. Slope ranges from 1 to 12 percent.

Typical pedon of Whitewright silty clay loam, in an area of Whitewright-Eddy-Howe complex, 5 to 12 percent slopes; from the intersection of Texas Highway 5 and Farm Road 121 in Van Alstyne, 0.75 mile east on Farm Road 121, 1.25 miles north on unpaved county road and 100 feet west of right-of-way, in pasture:

A1—0 to 5 inches; light brownish gray (10YR 6/2) silty clay loam, grayish brown (10YR 5/2) moist; moderate medium subangular blocky and granular structure; hard, friable; common medium and fine roots; few fine and medium pores; common worm casts; few weakly cemented fragments of chalk less than 10 millimeters; few strongly cemented fragments of calcite fragments 5 to 15 millimeters; about 60 percent calcium carbonate equivalent; calcareous; moderately alkaline; clear smooth boundary.

B2—5 to 16 inches; very pale brown (10YR 7/3) silty clay loam, pale brown (10YR 6/3) moist; few medium distinct brownish yellow (10YR 6/6) mottles; moderate fine and medium subangular blocky structure; hard, friable; common fine and medium roots; few fine pores; common worm casts; about 20 percent, by volume, weakly cemented platy chalky fragments of limestone, 5 to 20 millimeters on long axis; few fine shell fragments less than 5 millimeters; about 65 percent calcium carbonate equivalent; calcareous; moderately alkaline; abrupt wavy boundary.

Cr—16 to 34 inches; white (10YR 8/1) weakly cemented platy chalk fragments interbedded with olive yellow (2.5Y 6/6) silty clay loam; chalk fragments 2 to 6 centimeters in upper part, becoming coarser as depth increases; chalk is massive below a depth of 30 inches; common roots in vertical crevices and between horizontal plates.

The solum ranges from 10 to 20 inches in thickness. It is 2 to 30 percent, by volume, coarse fragments. The coarse fragments consist of platy, weakly cemented chalk ranging to 6 centimeters in length. More than 80 percent of the fragments slake if left overnight in water. Calcium carbonate equivalent is 40 to more than 80 percent.

The A horizon is dark grayish brown, grayish brown, brown, light brownish gray, pale brown, or very pale brown. It is silty clay loam, gravelly silty clay loam, loam, or gravelly loam.

The B horizon is brown, light brownish gray, pale brown, light yellowish brown, light gray, or very pale brown. Mottles in the B horizon range from none to common and are in shades of brown or yellow. This horizon is silty clay loam, gravelly silty clay loam, loam, or gravelly loam.

The Cr horizon is light brownish gray, light gray, very pale brown, or white weakly cemented platy chalk with a few strata of light yellowish brown, brownish yellow, olive yellow, or pale yellow silty clay loam. This horizon has 70 to 90 percent, by volume, chalk fragments that are soft and easily cut with spade, when moist.

Wilson series

The Wilson series consists of deep, loamy soils on nearly level and gently sloping terraces. These soils formed in ancient alluvium. Slope ranges from 0 to 3 percent.

Typical pedon of Wilson silty clay loam, 0 to 1 percent slopes; from the intersection of U.S. Highway 377 and Farm Road 902 Collinsville, 2.0 miles south on U.S. Highway 377, 1.1 miles east, 0.05 mile north, and 1.8 miles east on county road and 100 feet north of right-of-way, in bermudagrass pasture:

Ap—0 to 8 inches; dark gray (10YR 4/1) silty clay loam, very dark gray (10YR 3/1) moist; weak medium granular structure; extremely hard, friable; many fine roots; medium acid; abrupt smooth boundary.

B21tg—8 to 25 inches; dark gray (10YR 4/1) silty clay, very dark gray (10YR 3/1) moist; moderate medium blocky structure; extremely hard, extremely firm; common fine roots; neutral; gradual wavy boundary.

B22tg—25 to 34 inches; gray (10YR 5/1) silty clay, dark gray (10YR 4/1) moist; moderate medium blocky structure; extremely hard, extremely firm; few fine roots; mildly alkaline; gradual wavy boundary.

B23tg—34 to 57 inches; gray (10YR 5/1) silty clay, dark gray (10YR 4/1) moist; weak medium blocky structure; extremely hard, extremely firm; few fine roots; neutral; gradual wavy boundary.

B24t—57 to 65 inches; mottled light brownish gray (2.5Y 6/2), brownish yellow (10YR 6/6), and gray (10YR 5/1) silty clay; weak medium blocky structure; extremely hard, extremely firm; few fine roots; neutral.

The solum ranges from 48 to more than 60 inches in thickness.

The A horizon is very dark gray, dark gray, very dark grayish brown, dark grayish brown, grayish brown, or gray. It is medium acid through mildly alkaline.

The B21tg horizon is very dark gray or dark gray clay or silty clay. It is medium acid through mildly alkaline.

The B22tg and B23tg horizons are dark gray, gray, or grayish brown.

The reaction is neutral through moderately alkaline. Texture is clay or silty clay. In some pedons, there are mottles in shades of olive, brown, or yellow in the lower part.

The B24t horizon has colors in shades of gray, yellow, and brown. Texture is clay or silty clay. Reaction is neutral through moderately alkaline. Some pedons contain concretions of calcium carbonate and crystals of gypsum.

Zilaboy series

The Zilaboy series consists of deep, clayey soils on flood plains. These soils formed in clayey alluvium. Slope is 0 to 1 percent.

Typical pedon of Zilaboy clay from an area of Zilaboy soils, frequently flooded; from the intersection of Farm Road 121 and U.S. Highway 377 in Tioga; 1.8 miles north on U.S. Highway 377, 0.45 mile west on private road, 0.75 mile north along railroad and 800 feet east of railroad, in bermudagrass pasture:

A11—0 to 5 inches; dark grayish brown (10YR 4/2) clay, very dark grayish brown (2.5Y 3/2) moist; moderate fine and medium blocky structure; extremely hard, very firm, sticky and plastic; common fine roots; few very fine black concretions; slightly acid; gradual smooth boundary.

A12—5 to 18 inches; olive gray (5Y 4/2) clay, dark olive gray (5Y 3/2) moist; moderate fine and medium blocky structure; extremely hard, very firm, sticky and plastic; common fine roots; few intersecting slickensides in lower part; few very fine black concretions; slightly acid; gradual wavy boundary.

AC1—18 to 40 inches; grayish brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; common fine distinct reddish brown mottles; moderate fine and medium blocky structure; extremely hard, very firm, sticky and plastic; few fine roots; few intersecting slickensides; few very fine black concretions; slightly acid; gradual wavy boundary.

AC2—40 to 55 inches; olive (5Y 5/3) clay, olive (5Y 4/3) moist; weak medium and coarse subangular blocky structure; very hard, very firm; common intersecting slickensides; few very fine black concretions; neutral; gradual wavy boundary.

C—55 to 70 inches; olive (5Y 5/3) clay, olive (5Y 4/3) moist; weak coarse subangular blocky structure; very hard, very firm; few intersecting slickensides; few very fine black concretions; common medium masses of calcium carbonate; calcareous; mildly alkaline.

The solum ranges from 40 to 60 inches in thickness. Areas that have not been tilled have a subdued gilgai microrelief; the microknolls are 4 to 6 inches higher than the microdepressions. Texture is clay or silty clay and some pedons have a thin overwash or thin strata of silty clay loam or clay loam. Slickensides are at a depth of 14 to 24 inches.

The A horizon is grayish brown, dark gray, brown, olive gray, or very dark gray. It is slightly acid or neutral.

The AC horizon is grayish brown, olive gray, brown, or olive. It has distinct or prominent mottles of reddish brown, yellowish brown, yellow, olive, and brown within a depth of 20 inches. This horizon is slightly acid through mildly alkaline.

The C horizon is olive, brown, or gray and in some pedons has mottles of these colors. This horizon is neutral through moderately alkaline and is calcareous.

Classification of the soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (*4*). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. In table 18, the soils of the survey area are classified according to the system. The categories are defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Inceptisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Ochrept (*Ochr*, meaning light colored, plus *ept*, from Inceptisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Ustochrepts (*Ust*, meaning dry, plus *ochrept*, the suborder of the Inceptisols that have a light colored surface horizon).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Ustochrepts.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Mostly the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a

subgroup preceded by terms that indicate soil properties. An example is the Howe series a member of the fine-silty, carbonatic, thermic Typic Ustochrepts.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series.

Formation of the soils

This section discusses the factors of soil formation, relates them to the formation of soils in the survey area, and explains the processes of soil formation.

Factors of soil formation

The characteristics of the soil at any given point are determined by the physical and mineral composition of the parent material; the climate under which the parent material accumulated and has existed since accumulation; the plant and animal life on and in the soil; the relief, or lay of the land; and the length of time the forces of soil formation have acted on the soil material. All five of these factors influence the present characteristics of every soil, but the significance of each factor varies from one place to another. The parent material affects the kind of profile that can be formed. Climate and vegetation act on the parent material and slowly change it into a natural body that has genetically related horizons. Relief, however, conditions the effects that climate and vegetation have on the parent material. Finally, time is needed for changing of the parent material into a soil profile. A long time generally is required for the development of distinct horizons.

The interrelationship among these five factors is complex, and the effects of any one factor cannot be isolated and completely evaluated. It is convenient to discuss each factor separately, however, and to indicate the probable effects of each.

Climate

The climate of Grayson County is warm temperate, subtropical, and humid. It is believed that a climate similar to the present one existed when the soils were formed. Because the climate is uniform throughout the county, most differences in the soils are not the results of the effects of climate.

Parent material

Parent material is the unconsolidated mass from which a soil forms. It determines the chemical and mineral composition of the soil. In Grayson County the soils developed from material of Cretaceous and Recent ages.

Formations belonging to the Fredericksburg and Washita groups form a narrow band across the northern part of the county. Aledo and Purves soils, high in calcium carbonate, formed over these formations. Sanger soils, which are deeper and clayey, formed over the more easily weathered shales.

Formation of the Woodbine Group outcrop along the western part of the county and in a narrow band across the northern part. These formations are thick beds of sandstone with bands of shale. Gasil and Heaton soils formed over the sandstone, and are deep, sandy, and loamy soils. Aubrey soils formed over the bands of shale, and are moderately deep, clayey soils.

The Eagle Ford Formation is shale that outcrops in the southern part of the county. It weathers readily and forms clayey soils. Vertel soils formed over the Eagle Ford shale.

The Austin Group is chalk that covers the southeastern part of the county. Austin and Fairlie soils formed over the more nearly level parts of the chalk. They are dark, clayey, calcareous, moderately deep and deep soils. Whitewright and Eddy soils formed in the more sloping areas. They are shallow and very shallow, calcareous, loamy soils and are lighter in color than the Fairlie and Houston Black soils.

Deposits of Recent age are along the flood plains and were derived from a variety of sources. Erosion of Permian and Triassic redbeds have formed reddish clay deposits along the Red River. Redlake soils formed over these deposits. Elbon soils formed over clayey sediment rich in calcium carbonate from the Austin chalk areas. Whitesboro soils formed in loamy alluvial sediment.

Plants and animals

Plants, insects, bacteria, fungi, earthworms, and other living organisms have contributed to the development of the soils. Gains in organic matter and nitrogen in the soil, gains or losses in plant nutrients, and changes in structure and porosity are some of the changes caused by plant and animal life.

The soils of Grayson County formed under mid and tall grasses and wooded areas of blackjack oak and post oak. The soils that developed under grasses, such as Austin and Houston Black soils, have a high organic matter content. Soils, such as Gasil and Aubrey soils, that formed under trees are generally low in organic matter content.

Relief

Relief affects soil formation through its effect on drainage, erosion, plant cover, and soil temperature. The soils in Grayson County range from nearly level to steep.

The nearly level to gently sloping soils on uplands, such as Houston Black and Fairlie soils, have slow but adequate drainage and have black colors that extend to a depth of more than 40 inches.

The more sloping soils have a moderate or severe erosion hazard, if unprotected. Eddy and Whitewright soils are lighter colored and have a thinner profile than

less sloping soils, because material is removed from the slopes by water erosion about as fast as the surface layer forms. The plant cover generally is thinner on many of the more sloping areas.

Soils that receive additional water from runoff or do not have adequate drainage have developed gleyed characteristics. Wilson soils have these characteristics.

Soil temperature varies slightly according to position of the slopes. During summer, soils that have slopes facing north are slightly cooler than those that have slopes facing south, and generally produce more vegetation.

Time

Time, generally a long time, is required for distinct horizons to form in soils. The length of time that parent materials have been in place is commonly reflected by the degree of development of the soil horizons. This applies mainly to soils that are in favorable positions for soil development.

The Elbon soils in Grayson County do not have well developed horizons. Except for darkening of the surface layer, these soils retain many characteristics of their calcareous, clayey parent material. The Normangee soils, which are on the uplands, are an example of older soils that have well developed horizons. These soils formed in calcareous clays and shales. After hundreds of years of leaching and eluviation, a noncalcareous, blocky, clay subsoil has developed in these soils. The subsoil resembles only slightly the original parent material.

Processes of soil horizon differentiation

The differentiation of soil horizons in Grayson County is the result of several processes. Among these are accumulation of organic matter, leaching of carbonates and salts, reduction and transfer of iron, and translocation of silicate clay minerals. In most soils more than one of these processes have been active in the development of horizons.

Accumulation of organic matter in the upper part of a profile helps to form an A1 horizon. The soils in Grayson County range from low to high in content of organic matter. The Heaton soils have a low content of organic matter, and the Fairlie soils have a high content.

Much leaching of carbonates and salts has occurred in Wilson and Mabank soils. The Houston Black soils are only slightly leached. These clayey soils have a thick A horizon that is high in carbonates.

Reduction and transfer of iron, a process called gleying, is evident in the poorly drained soils of the county. The gray color in the subsoil indicates reduction and loss of iron. Some horizons have pale yellow to brown mottles and concretions, indicating a segregation of iron. The Wilson soils are examples of somewhat poorly drained, grayish soils that are mottled in the lower horizons.

Translocation of clay minerals has taken place in Crockett and Wilson soils. This has contributed to horizon development. The B horizon generally has accumulations of clay (clay films) in the pores and on surfaces of peds. These soils were probably leached of carbonates and soluble salts before translocation of silicate clays took place.

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(3) United States Department of Agriculture. 1951. Soil survey manual. U.S. Dep. Agric. Handb. 18, 503 pp., illus. [Supplements replacing pp. 173-188 issued May 1962]

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Glossary

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	More than 12

Bedding planes. Fine stratifications, less than 5 millimeters thick, in unconsolidated alluvial, eolian, lacustrine, or marine sediments.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bottom land. The normal flood plain of a stream, subject to flooding.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Coarse fragments. Mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter.

Complex slope. Irregular or variable slope. Planning or constructing terraces, diversions, and other water-control measures on a complex slope is difficult.

Complex, soil. A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

Compressible (in tables). Excessive decrease in volume of soft soil under load.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Contour stripcropping (or contour farming). Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Depth to rock. Bedrock is too near the surface for the specified use.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically for long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high

water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Drainage, surface. Runoff, or surface flow of water, from an area.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes the surface.

Excess fines (in tables). Excess silt and clay in the soil. The soil does not provide a source of gravel or sand for construction purposes.

Fast intake (in tables). The rapid movement of water into the soil.

Favorable. Favorable soil features for the specified use.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Gilgai. Commonly a succession of microbasins and microknolls in nearly level areas or of microvalleys and microridges parallel with the slope. Typically, the microrelief of Vertisols—clayey soils having a high coefficient of expansion and contraction with changes in moisture content.

Gleyed soil. Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors and mottles.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.5 centimeters) in diameter. An individual piece is a pebble.

Ground water (geology). Water filling all the unblocked pores of underlying material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Habitat. The natural abode of a plant or animal; refers to the kind of environment in which a plant or animal normally lives, as opposed to the range or geographical distribution.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an upper case letter represents the major horizons. Numbers or lower case letters that follow represent subdivisions of the major horizons. An explanation of the subdivisions is given in the *Soil Survey Manual*. The major horizons of mineral soil are as follows:

O horizon.—An organic layer of fresh and decaying plant residue at the surface of a mineral soil.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of transition from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil does not have a B horizon, the A horizon alone is the solum.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the A or B horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, the Roman numeral II precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock commonly underlies a C horizon, but can be directly below an A or a B horizon.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Large stones (in tables). Rock fragments 3 inches (7.5 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Leaching. The removal of soluble material from soil or other material by percolating water.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Low strength. The soil is not strong enough to support loads.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Munsell notation. A designation of color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.20 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Rangeland. Land on which the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. It includes natural grasslands, savannas, many wetlands, some deserts, tundras, and areas that support certain forb and shrub communities.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction be-

cause it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid	Below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Rill. A steep sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called groundwater runoff or seepage flow from ground water.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone. Sedimentary rock containing dominantly sand-size particles.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the underlying material. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and runoff water.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks, prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slow intake (in tables). The slow movement of water into the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.5 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 mm in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows:

	Millimeters
Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	Less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Stratified. Arranged in strata, or layers. The term refers to geologic material. Layers in soils that result from the processes of soil formation are called horizons; those inherited from the parent material are called strata.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils

are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt, silt loam, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or " very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Variant, soil. A soil having properties sufficiently different from those of other known soils to justify a new series name, but occurring in such a limited geographic area that creation of a new series is not justified.

Water table. The upper limit of the soil or underlying rock material that is wholly saturated with water.

Water table, apparent. A thick zone of free water in the soil. An apparent water table is indicated by the level which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrouning soil.

Water table, artesian. A water table under hydrostatic head, generally beneath an impermeable layer. When this layer is penetrated, the water level rises in an uncased borehole.

Water table, perched. A water table standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

TABLES

TABLE 1.--TEMPERATURE AND PRECIPITATION

[Recorded in the period 1951-75 at Sherman, Texas]

Month	Temperature						Precipitation				
	Average daily maximum	Average daily minimum	Average daily	2 years in 10 will have-- Maximum temperature higher than--	2 years in 10 will have-- Minimum temperature lower than--	Average number of growing degree days[1]	Average	2 years in 10 will have-- Less than--	2 years in 10 will have-- More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
January----	52.7	30.6	41.7	79	9	24	1.69	.67	2.51	4	1.4
February---	57.2	34.6	45.9	82	14	52	2.47	1.02	3.64	5	1.4
March------	64.4	41.6	53.0	87	20	196	2.84	1.03	4.28	6	.2
April------	74.6	52.3	63.5	91	31	405	4.87	2.04	7.16	6	.0
May--------	82.0	60.6	71.3	96	43	660	5.52	2.82	7.73	7	.0
June-------	89.9	68.5	79.3	100	54	879	3.70	1.62	5.39	6	.0
July-------	95.0	72.6	83.8	105	60	1,048	2.29	.53	3.67	4	.0
August-----	95.3	71.3	83.3	105	59	1,032	2.20	.77	3.33	4	.0
September--	87.4	64.3	75.9	102	47	777	5.06	1.80	7.66	5	.0
October----	77.7	53.5	65.6	95	35	484	3.43	.79	5.49	4	.0
November---	64.5	41.8	53.2	84	22	157	2.89	1.00	4.42	4	.0
December---	55.4	33.8	44.7	79	12	37	2.23	.88	3.31	4	.4
Yearly:											
Average--	74.7	52.1	63.4	---	---	---	---	---	---	---	---
Extreme--	---	---	---	107	7	---	---	---	---	---	---
Total----	---	---	---	---	---	5,751	39.19	30.63	47.23	59	3.4

[1]A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (50 °F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

[Recorded in the period 1951-75 at Sherman, Texas]

Probability	Temperature		
	24°F or lower	28°F or lower	32°F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	March 20	April 4	April 13
2 years in 10 later than--	March 12	March 27	April 6
5 years in 10 later than--	February 24	March 12	March 24
First freezing temperature in fall:			
1 year in 10 earlier than--	November 13	November 1	October 26
2 years in 10 earlier than--	November 21	November 9	October 31
5 years in 10 earlier than--	December 6	November 25	November 11

TABLE 3.--GROWING SEASON LENGTH

[Recorded in the period 1951-75 at Sherman, Texas]

Probability	Daily minimum temperature during growing season		
	Higher than 24°F	Higher than 28°F	Higher than 32°F
	Days	Days	Days
9 years in 10	251	219	204
8 years in 10	262	232	213
5 years in 10	284	257	231
2 years in 10	306	282	250
1 year in 10	317	296	259

Table 4.--POTENTIALS AND LIMITATIONS OF MAP UNITS FOR SPECIFIED USES

Map unit	Extent of area	Cultivated crops	Pasture	Range	Urban uses	Recreation
	Pct					
1. Normangee-Crockett-Wilson----	27	Medium: erodes easily.	High----------	Medium: droughty.	Medium: shrink-swell, low strength, percs slowly.	Medium: percs slowly.
2. Fairlie-Austin-Houston Black-	24	High----------	High----------	High----------	Low: shrink-swell, low strength.	Low: too clayey.
3. Vertel-Heiden----------	11	Medium: erodes easily.	Medium: droughty, erodes easily.	High----------	Low: shrink-swell, low strength.	Low: too clayey.
4. Sanger-Bolar----------	2	Medium: erodes easily, slope.	Medium: erodes easily.	High----------	Low: shrink-swell, percs slowly.	Low: too clayey.
5. Callisburg-Crosstell-Gasil---	16	Medium: erodes easily.	Medium: droughty.	Medium: droughty.	Medium: shrink-swell, low strength.	Medium: too sandy, percs slowly.
6. Whitewright-Howe-Eddy--------	8	Low: erodes easily, rooting depth.	Low: rooting depth.	Low: rooting depth.	Medium: depth to rock, shrink-swell.	Medium: small stones, too clayey.
7. Aubrey----------	2	Low: large stones, too acid.	Low: large stones, too acid.	Low: too acid, large stones.	Medium: large stones, shrink-swell.	Medium: large stones, percs slowly.
8. Elbon-Trinity-Redlake--------	3	High----------	High----------	High----------	Low: flooding.	Low: flooding.
9. Bastrop-Okay-Oklared---------	2	High----------	High----------	High----------	High----------	High.

TABLE 5.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
1	Aledo gravelly clay loam, 3 to 8 percent slopes	900	0.1
2	Aledo soils, hilly	3,350	0.5
3	Altoga clay loam, 5 to 8 percent slopes	5,100	0.8
4	Aubrey fine sandy loam, 5 to 8 percent slopes	11,220	1.8
5	Aubrey-Birome complex, 3 to 12 percent slopes	15,910	2.5
6	Aubrey-Birome-Urban land complex, 3 to 12 percent slopes	620	0.1
7	Aubrey soils, 3 to 8 percent slopes, severely eroded	4,320	0.7
8	Austin silty clay, 1 to 3 percent slopes	12,610	2.0
9	Austin silty clay, 3 to 5 percent slopes	17,180	2.7
10	Austin-Urban land complex, 1 to 5 percent slopes	1,490	0.2
11	Bastrop loam, 0 to 1 percent slopes	2,210	0.4
12	Bastrop loam, 1 to 3 percent slopes	1,040	0.2
13	Bolar clay loam, 1 to 5 percent slopes	1,410	0.2
14	Bolar clay loam, 5 to 8 percent slopes	830	0.1
15	Bolar-Aledo complex, 3 to 12 percent slopes	3,070	0.5
16	Bunyan and Whitesboro soils, frequently flooded	17,810	2.8
17	Callisburg fine sandy loam, 1 to 3 percent slopes	4,210	0.7
18	Callisburg fine sandy loam, 2 to 5 percent slopes, eroded	9,770	1.6
19	Callisburg fine sandy loam, 5 to 8 percent slopes	4,780	0.8
20	Callisburg soils, 3 to 8 percent slopes, severely eroded	3,460	0.5
21	Crockett loam, 0 to 1 percent slopes	4,300	0.7
22	Crockett loam, 1 to 3 percent slopes	20,000	3.2
23	Crockett loam, 2 to 5 percent slopes, eroded	25,410	4.0
24	Crockett-Urban land complex, 0 to 3 percent slopes	950	0.2
25	Crosstell fine sandy loam, 1 to 3 percent slopes	2,650	0.4
26	Crosstell fine sandy loam, 2 to 5 percent slopes, eroded	17,550	2.8
27	Crosstell-Urban land complex, 1 to 5 percent slopes	1,680	0.3
28	Eddy gravelly clay loam, 5 to 12 percent slopes	5,000	0.8
29	Elbon clay, occasionally flooded	11,730	1.9
30	Elbon soils, frequently flooded	13,740	2.2
31	Fairlie-Urban land complex, 1 to 5 percent slopes	2,080	0.3
32	Fairlie and Houston Black clays, 0 to 1 percent slopes	4,850	0.8
33	Fairlie and Houston Black clays, 1 to 3 percent slopes	67,120	10.7
34	Gasil loamy fine sand, 1 to 5 percent slopes	8,650	1.4
35	Gasil loamy fine sand, 5 to 8 percent slopes	2,120	0.3
36	Gasil-Urban land complex, 1 to 8 percent slopes	1,470	0.2
37	Gasil soils, 2 to 5 percent slopes, eroded	5,280	0.8
38	Heaton loamy fine sand, 1 to 5 percent slopes	1,020	0.2
39	Heiden clay, 1 to 3 percent slopes	14,080	2.2
40	Heiden clay, 3 to 5 percent slopes	17,180	2.7
41	Howe silty clay loam, 5 to 8 percent slopes	8,260	1.3
42	Konsil loamy fine sand, 1 to 5 percent slopes	1,510	0.2
43	Konsil fine sandy loam, 2 to 5 percent slopes	9,390	1.5
44	Konsil fine sandy loam, 5 to 8 percent slopes	3,380	0.5
45	Konsil fine sandy loam, 5 to 8 percent slopes, eroded	1,580	0.3
46	Lewisville silty clay, 1 to 3 percent slopes	2,200	0.3
47	Lewisville silty clay, 3 to 5 percent slopes	4,170	0.7
48	Lindy loam, 1 to 3 percent slopes	5,500	0.9
49	Lindy-Urban land complex, 1 to 3 percent slopes	100	*
50	Mabank loam, 0 to 1 percent slopes	7,340	1.2
51	Mabank loam, 1 to 3 percent slopes	6,060	1.0
52	Normangee clay loam, 1 to 4 percent slopes	44,290	7.0
53	Normangee clay loam, 4 to 8 percent slopes	4,410	0.7
54	Normangee-Urban land complex, 1 to 4 percent slopes	2,400	0.4
55	Normangee soils, 3 to 8 percent slopes, severely eroded	4,430	0.7
56	Okay fine sandy loam, 0 to 1 percent slopes	1,410	0.2
57	Oklared very fine sandy loam	1,240	0.2
58	Oklared-Kiomatia complex, occasionally flooded	650	0.1
59	Pits	1,400	0.2
60	Purves clay loam, 1 to 5 percent slopes	1,950	0.3
61	Redlake clay, occasionally flooded	2,000	0.3
62	Sanger clay, 1 to 3 percent slopes	2,110	0.3
63	Sanger clay, 3 to 5 percent slopes	1,260	0.2
64	Sanger stony clay, 3 to 8 percent slopes	2,840	0.5
65	Speck Variant loam, 1 to 3 percent slopes	1,420	0.2
66	Stephen silty clay, 1 to 3 percent slopes	2,490	0.4
67	Stephen silty clay, 3 to 5 percent slopes	1,780	0.3
68	Trinity clay, occasionally flooded	5,500	0.9
69	Urban land	1,700	0.3
70	Vertel clay, 1 to 3 percent slopes	2,700	0.4

See footnote at end of table.

TABLE 5.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS--Continued

Map symbol	Soil name	Acres	Percent
71	Vertel clay, 3 to 5 percent slopes	19,970	3.2
72	Vertel clay, 5 to 12 percent slopes	16,950	2.7
73	Vertel clay, 5 to 8 percent slopes, severely eroded	3,300	0.5
74	Vertel-Urban land complex, 8 to 12 percent slopes	100	*
75	Whitesboro loam, occasionally flooded	1,280	0.2
76	Whitewright-Eddy-Howe complex, 1 to 5 percent slopes	7,670	1.2
77	Whitewright-Eddy-Howe complex, 5 to 12 percent slopes	20,420	3.2
78	Whitewright-Gullied land complex	5,650	0.9
79	Wilson silty clay loam, 0 to 1 percent slopes	17,390	2.8
80	Wilson silty clay loam, 1 to 3 percent slopes	21,690	3.4
81	Zilaboy soils, frequently flooded	3,560	0.6
	Water	28,160	4.5
	Total	629,760	100.0

* Less than 0.1 percent.

TABLE 6.--YIELDS PER ACRE OF CROPS AND PASTURE

[Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil]

Soil name and map symbol	Cotton lint	Grain sorghum	Wheat	Peanuts	Improved bermudagrass
	Lb	Bu	Bu	Lb	AUM*
1---------- Aledo	---	---	---	---	---
2---------- Aledo	---	---	---	---	---
3---------- Altoga	225	35	30	---	5.0
4---------- Aubrey	200	35	---	---	4.0
5---------- Aubrey	---	---	---	---	---
6---------- Aubrey	---	---	---	---	---
7---------- Aubrey	---	---	---	---	1.5
8---------- Austin	350	75	40	---	6.5
9---------- Austin	300	65	35	---	6.0
10---------- Austin	---	---	---	---	---
11---------- Bastrop	400	70	35	1,250	7.0
12---------- Bastrop	350	55	30	1,200	7.0
13---------- Bolar	---	35	20	---	5.0
14---------- Bolar	---	30	15	---	4.5
15---------- Bolar	---	---	---	---	---
16---------- Bunyan	---	---	---	---	8.0
17---------- Callisburg	300	50	30	---	5.5
18---------- Callisburg	250	45	30	---	5.0
19---------- Callisburg	150	40	20	---	5.0
20---------- Callisburg	---	---	---	---	4.0
21---------- Crockett	400	58	30	---	7.5

See footnotes at end of table.

TABLE 6.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Cotton lint	Grain sorghum	Wheat	Peanuts	Improved bermudagrass
	Lb	Bu	Bu	Lb	AUM*
22--Crockett	350	54	30	---	7.5
23--Crockett	200	45	20	---	5.5
24--Crockett	---	---	---	---	---
25--Crosstell	250	40	---	---	5.0
26--Crosstell	150	30	---	---	4.5
27--Crosstell	---	---	---	---	---
28--Eddy	---	---	---	---	---
29--Elbon	600	90	40	---	8.0
30--Elbon	---	---	---	---	8.0
31--Fairlie	---	---	---	---	---
32--Fairlie	500	87	37	---	8.0
33--Fairlie	450	82	36	---	8.0
34--Gasil	200	45	25	1,200	5.0
35--Gasil	100	35	15	1,000	5.0
36--Gasil	---	---	---	---	---
37--Gasil	200	---	20	900	5.0
38--Heaton	---	40	---	1,200	5.5
39--Heiden	400	80	30	---	8.0
40--Heiden	350	55	25	---	6.0
41--Howe	200	30	20	---	4.5
42--Konsil	200	45	25	1,200	5.0
43--Konsil	250	50	25	1,200	5.5
44--Konsil	150	40	20	1,000	5.0

See footnotes at end of table.

TABLE 6.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Cotton lint	Grain sorghum	Wheat	Peanuts	Improved bermudagrass
	Lb	Bu	Bu	Lb	AUM*
45---------- Konsil	---	---	---	---	4.5
46---------- Lewisville	500	80	35	---	7.5
47---------- Lewisville	375	70	30	---	7.0
48---------- Lindy	250	55	25	---	5.0
49---------- Lindy	---	---	---	---	---
50---------- Mabank	330	55	30	---	6.0
51---------- Mabank	300	45	25	---	6.0
52---------- Normangee	300	50	30	---	8.0
53---------- Normangee	---	---	---	---	7.0
54---------- Normangee	---	---	---	---	---
55---------- Normangee	---	---	---	---	5.0
56---------- Okay	500	60	40	1,800	8.0
57**---------- Oklared	650	65	---	1,800	8.0
58---------- Oklared	535	53	---	---	8.0
59***. Pits					
60---------- Purves	---	25	20	---	3.5
61---------- Redlake	550	70	35	---	7.0
62---------- Sanger	350	70	30	---	6.5
63---------- Sanger	300	65	20	---	6.0
64---------- Sanger	---	---	---	---	3.5
65---------- Speck Variant	250	50	30	---	4.0
66---------- Stephen	250	55	25	---	4.0
67---------- Stephen	150	45	20	---	3.5

See footnotes at end of table.

TABLE 6.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Cotton lint	Grain sorghum	Wheat	Peanuts	Improved bermudagrass
	Lb	Bu	Bu	Lb	AUM*
68---------- Trinity	450	100	40	---	8.0
69***. Urban land					
70---------- Vertel	300	30	20	---	5.0
71---------- Vertel	---	25	15	---	4.0
72---------- Vertel	---	---	---	---	3.0
73---------- Vertel	---	---	---	---	---
74---------- Vertel	---	---	---	---	---
75---------- Whitesboro	500	75	35	1,800	8.0
76---------- Whitewright	---	30	20	---	---
77---------- Whitewright	---	---	---	---	---
78---------- Whitewright	---	---	---	---	---
79---------- Wilson	350	55	30	---	---
80---------- Wilson	300	45	25	---	---
81---------- Zilaboy	---	---	---	---	7.0

* Animal-unit-month: The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for 30 days.
** Yields are for areas protected from flooding.
*** See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 7.--CAPABILITY CLASSES AND SUBCLASSES

[Miscellaneous areas are excluded. Absence of an entry indicates no acreage]

Class	Total acreage	Major management concerns (Subclass)			
		Erosion (e)	Wetness (w)	Soil problem (s)	Climate (c)
		Acres	Acres	Acres	Acres
I	4,860	---	---	---	---
II	102,740	90,759	11,981	---	---
III	223,062	180,003	38,460	4,599	---
IV	130,587	130,587	---	---	---
V	35,109	---	35,109	---	---
VI	73,275	66,466	---	6,809	---
VII	22,899	3,300	---	19,599	---
VIII	---	---	---	---	---

TABLE 8.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES

[Only the soils that support rangeland vegetation suitable for grazing are listed]

Soil name and map symbol	Range site	Total production		Characteristic vegetation	Composition
		Kind of year	Dry weight		
			Lb/acre		Pct
1---------- Aledo	Shallow----------	Favorable	3,000	Little bluestem----------	30
		Normal	2,000	Indiangrass----------	15
		Unfavorable	1,800	Sideoats grama----------	10
				Big bluestem----------	10
				Switchgrass----------	5
				Silver bluestem----------	5
				Hairy grama----------	5
				Hairy dropseed----------	5
				Texas needlegrass----------	5
2*---------- Aledo	Rocky Hills----------	Favorable	2,500	Little bluestem----------	25
		Normal	1,800	Sideoats grama----------	10
		Unfavorable	1,200	Indiangrass----------	10
				Big bluestem----------	10
				Silver bluestem----------	5
				Hairy grama----------	5
				Hairy dropseed----------	5
				Texas needlegrass----------	5
3---------- Altoga	Clay Loam----------	Favorable	6,500	Little bluestem----------	35
		Normal	5,000	Big bluestem----------	20
		Unfavorable	3,800	Indiangrass----------	15
				Switchgrass----------	5
				Florida paspalum----------	5
				Virginia wildrye----------	5
				Sideoats grama----------	5
4---------- Aubrey	Tight Sandy Loam----------	Favorable	4,500	Little bluestem----------	25
		Normal	3,500	Sideoats grama----------	25
		Unfavorable	2,000	Post oak----------	10
				Big bluestem----------	5
				Purpletop----------	5
				Panicum----------	5
				Blackjack oak----------	5
5*:					
Aubrey----------	Sandstone Hill----------	Favorable	4,500	Little bluestem----------	25
		Normal	3,500	Indiangrass----------	10
		Unfavorable	2,000	Panicum----------	10
				Post oak----------	10
				Switchgrass----------	5
				Purpletop----------	5
				Blackjack oak----------	5
				Sedge----------	5
Birome----------	Sandstone Hill----------	Favorable	4,500	Little bluestem----------	25
		Normal	3,500	Indiangrass----------	10
		Unfavorable	2,000	Post oak----------	10
				Switchgrass----------	5
				Purpletop----------	5
				Beaked panicum----------	5
				Scribner panicum----------	5
				Sedge----------	5
				Blackjack oak----------	5
7*---------- Aubrey	Tight Sandy Loam----------	Favorable	4,500	Little bluestem----------	25
		Normal	3,500	Sideoats grama----------	25
		Unfavorable	2,000	Post oak----------	10
				Big bluestem----------	5
				Purpletop----------	5
				Panicum----------	5
				Blackjack oak----------	5

See footnote at end of table.

TABLE 8.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site	Total production		Characteristic vegetation	Composition
		Kind of year	Dry weight		
			Lb/acre		Pct
8, 9---------- Austin	Clay Loam----------	Favorable	6,500	Little bluestem----------	35
		Normal	5,000	Indiangrass----------	15
		Unfavorable	3,000	Big bluestem----------	15
				Sideoats grama----------	5
				Switchgrass----------	5
				Silver bluestem----------	5
				Texas needlegrass----------	5
11, 12---------- Bastrop	Sandy Loam----------	Favorable	5,000	Little bluestem----------	50
		Normal	4,000	Indiangrass----------	10
		Unfavorable	2,000	Switchgrass----------	5
				Purpletop----------	5
				Sideoats grama----------	5
13, 14---------- Bolar	Clay Loam----------	Favorable	6,000	Little bluestem----------	35
		Normal	5,000	Indiangrass----------	15
		Unfavorable	3,000	Big bluestem----------	10
				Sideoats grama----------	10
				Silver bluestem----------	5
				Tall dropseed----------	5
				Texas needlegrass----------	5
				Canada wildrye----------	5
15*:					
Bolar----------	Clay Loam----------	Favorable	6,000	Little bluestem----------	35
		Normal	5,000	Indiangrass----------	15
		Unfavorable	3,000	Big bluestem----------	10
				Sideoats grama----------	10
				Silver bluestem----------	5
				Tall dropseed----------	5
				Texas needlegrass----------	5
				Canada wildrye----------	5
Aledo----------	Shallow----------	Favorable	3,000	Little bluestem----------	30
		Normal	2,000	Indiangrass----------	15
		Unfavorable	1,800	Sideoats grama----------	10
				Big bluestem----------	10
				Switchgrass----------	5
				Silver bluestem----------	5
				Hairy grama----------	5
				Hairy dropseed----------	5
				Texas needlegrass----------	5
16*:					
Bunyan----------	Loamy Bottomland----------	Favorable	6,500	Indiangrass----------	20
		Normal	5,000	Switchgrass----------	15
		Unfavorable	3,500	Big bluestem----------	10
				Little bluestem----------	10
				Tall dropseed----------	5
				Texas needlegrass----------	5
				Sideoats grama----------	5
				Vine-mesquite----------	5
Whitesboro--------	Loamy Bottomland----------	Favorable	9,000	Virginia wildrye----------	15
		Normal	8,000	Beaked panicum----------	15
		Unfavorable	6,500	Switchgrass----------	5
				Indiangrass----------	5
				Little bluestem----------	5
				White tridens----------	5
				Panicum----------	5
				Eastern gamagrass----------	5
17, 18, 19, 20*---- Callisburg	Sandy Loam----------	Favorable	6,000	Little bluestem----------	45
		Normal	4,500	Indiangrass----------	10
		Unfavorable	3,500	Switchgrass----------	10
				Sand lovegrass----------	5

See footnote at end of table.

TABLE 8.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site	Total production		Characteristic vegetation	Composition
		Kind of year	Dry weight		
			Lb/acre		Pct
21, 22, 23--------- Crockett	Claypan Prairie----------	Favorable Normal Unfavorable	5,500 4,500 3,000	Little bluestem---------- Indiangrass---------- Virginia wildrye---------- Florida paspalum---------- Texas needlegrass---------- Silver bluestem---------- Paspalum---------- Big bluestem----------	50 10 10 10 5 5 5 5
25, 26---------- Crosstell	Tight Sandy Loam----------	Favorable Normal Unfavorable	4,500 3,500 2,000	Little bluestem---------- Sideoats grama---------- Big bluestem---------- Indiangrass---------- Tall dropseed---------- Purpletop---------- Silver bluestem----------	25 25 5 5 5 5 5
28---------- Eddy	Chalky Ridge----------	Favorable Normal Unfavorable	4,500 3,500 2,000	Little bluestem---------- Indiangrass---------- Big bluestem---------- Sideoats grama---------- Texas needlegrass---------- Silver bluestem---------- Hairy grama----------	30 15 10 10 5 5 5
29, 30*---------- Elbon	Clayey Bottomland----------	Favorable Normal Unfavorable	6,000 5,000 3,500	Sedge---------- Virginia wildrye---------- Beaked panicum---------- Panicum---------- Switchcane---------- Purpletop---------- Little bluestem---------- Mississippi dropseed---------- Florida paspalum----------	15 10 10 10 5 5 5 5 5
32*, 33*: Fairlie----------	Blackland----------	Favorable Normal Unfavorable	7,000 6,000 3,500	Little bluestem---------- Eastern gamagrass---------- Indiangrass---------- Switchgrass---------- Sideoats grama---------- Meadow dropseed----------	40 20 15 10 5 5
Houston Black-----	Blackland----------	Favorable Normal Unfavorable	7,000 6,000 3,500	Little bluestem---------- Indiangrass---------- Switchgrass---------- Sideoats grama---------- Vine-mesquite----------	50 25 5 5 5
34, 35---------- Gasil	Sandy Loam----------	Favorable Normal Unfavorable	5,500 4,500 3,500	Little bluestem---------- Indiangrass---------- Beaked panicum---------- Virginia wildrye----------	45 10 10 5
37*---------- Gasil	Sandy Loam----------	Favorable Normal Unfavorable	5,500 4,500 3,500	Little bluestem---------- Indiangrass---------- Beaked panicum---------- Virginia wildrye----------	45 10 10 5

See footnote at end of table.

TABLE 8.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site	Total production		Characteristic vegetation	Composition
		Kind of year	Dry weight		
			Lb/acre		Pct
38---------- Heaton	Sandy----------	Favorable Normal Unfavorable	4,500 3,500 2,000	Little bluestem---------- Big bluestem---------- Indiangrass---------- Post oak---------- Blackjack oak---------- Sand lovegrass---------- Purpletop---------- Tall dropseed---------- Silver bluestem---------- Scribner panicum----------	25 10 10 8 7 5 5 5 5 5
39, 40---------- Heiden	Blackland----------	Favorable Normal Unfavorable	7,000 6,000 3,500	Little bluestem---------- Big bluestem---------- Indiangrass----------	50 15 10
41---------- Howe	Clay Loam----------	Favorable Normal Unfavorable	6,500 5,000 3,000	Little bluestem---------- Indiangrass---------- Big bluestem---------- Sideoats grama---------- Switchgrass---------- Silver bluestem---------- Texas needlegrass----------	35 15 15 5 5 5 5
42, 43, 44, 45----- Konsil	Sandy Loam----------	Favorable Normal Unfavorable	5,500 4,500 3,500	Little bluestem---------- Indiangrass---------- Big bluestem---------- Post oak---------- Purpletop---------- Sand lovegrass---------- Blackjack oak----------	45 10 10 10 5 5 5
46, 47---------- Lewisville	Clay Loam----------	Favorable Normal Unfavorable	6,500 5,500 3,500	Little bluestem---------- Indiangrass---------- Big bluestem---------- Switchgrass---------- Texas needlegrass---------- Virginia wildrye---------- Torrey silver bluestem--------- Meadow dropseed---------- Buffalograss---------- Sideoats grama----------	20 15 15 10 5 5 5 5 5 5
48---------- Lindy	Deep Redland----------	Favorable Normal Unfavorable	6,000 5,000 4,000	Big bluestem---------- Indiangrass---------- Little bluestem---------- Sideoats grama---------- Tall dropseed---------- Silver bluestem---------- Plains lovegrass---------- Texas needlegrass---------- Canada wildrye----------	20 20 15 5 5 5 5 5 5
50, 51---------- Mabank	Claypan Prairie----------	Favorable Normal Unfavorable	5,500 4,500 3,000	Little bluestem---------- Big bluestem---------- Indiangrass---------- Switchgrass---------- Virginia wildrye---------- Texas needlegrass---------- Torrey silver bluestem--------- Meadow dropseed----------	35 15 15 10 5 5 5 5
52, 53---------- Normangee	Claypan Prairie----------	Favorable Normal Unfavorable	5,500 4,000 3,000	Little bluestem---------- Indiangrass---------- Big bluestem---------- Switchgrass---------- Florida paspalum---------- Sideoats grama----------	45 15 10 10 5 5

See footnote at end of table.

TABLE 8.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site	Total production		Characteristic vegetation	Composition
		Kind of year	Dry weight		
			Lb/acre		Pct
55* Normangee	Claypan Prairie	Favorable Normal Unfavorable	5,500 4,000 3,000	Little bluestem Indiangrass Big bluestem Switchgrass Florida paspalum Sideoats grama	50 15 10 10 5 5
56 Okay	Sandy Loam	Favorable Normal Unfavorable	7,000 5,500 4,500	Big bluestem Indiangrass Little bluestem Switchgrass Scribner panicum Catclaw sensitivebrier	35 15 10 10 5 5
57 Oklared	Loamy Bottomland	Favorable Normal Unfavorable	6,500 5,000 4,000	Big bluestem Little bluestem Switchgrass Beaked panicum Sedge	25 15 10 5 5
58*: Oklared	Loamy Bottomland	Favorable Normal Unfavorable	6,500 5,000 4,000	Big bluestem Little bluestem Switchgrass Beaked panicum Sedge	25 15 10 5 5
Kiomatia	Sandy Bottomland	Favorable Normal Unfavorable	5,000 4,000 2,500	Beaked panicum Giant cane Sedge Virginia wildrye Purpletop Longleaf uniola	20 20 10 10 10 5
60 Purves	Shallow	Favorable Normal Unfavorable	3,000 2,500 1,800	Little bluestem Indiangrass Big bluestem Sideoats grama Switchgrass Hairy grama Texas needlegrass Silver bluestem	30 15 10 10 5 5 5 5
61 Redlake	Clayey Bottomland	Favorable Normal Unfavorable	6,500 5,000 3,500	Giant cane Canada wildrye Sedge Switchgrass Indiangrass Broadleaf uniola Eastern gamagrass	15 10 10 10 10 5 5
62, 63, 64 Sanger	Blackland	Favorable Normal Unfavorable	6,000 5,000 3,000	Little bluestem Big bluestem Sideoats grama Texas needlegrass Meadow dropseed Buffalograss Silver bluestem	45 10 5 5 5 5 5
65 Speck Variant	Redland	Favorable Normal Unfavorable	5,000 4,000 2,500	Little bluestem Indiangrass Sideoats grama Big bluestem Silver bluestem Switchgrass Blue grama	30 20 10 5 5 5 5

See footnote at end of table.

TABLE 8.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site	Total production		Characteristic vegetation	Composition
		Kind of year	Dry weight		
			Lb/acre		Pct
66, 67---------- Stephen	Chalky Ridge----------	Favorable	4,500	Little bluestem----------	30
		Normal	3,500	Indiangrass----------	15
		Unfavorable	2,000	Big bluestem----------	10
				Sideoats grama----------	10
				Texas needlegrass----------	5
				Silver bluestem----------	5
				Hairy grama----------	5
68---------- Trinity	Clayey Bottomland----------	Favorable	6,500	Virginia wildrye----------	15
		Normal	5,000	Sedge----------	15
		Unfavorable	3,500	Eastern gamagrass----------	10
				Switchgrass----------	10
				Indiangrass----------	10
				Giant cane----------	5
				Beaked panicum----------	5
				Panicum----------	5
70, 71, 72, 73----- Vertel	Eroded Blackland----------	Favorable	5,000	Little bluestem----------	40
		Normal	4,000	Big bluestem----------	15
		Unfavorable	3,000	Indiangrass----------	10
				Switchgrass----------	10
				Virginia wildrye----------	5
				Vine-mesquite----------	5
				Texas needlegrass----------	5
75---------- Whitesboro	Loamy Bottomland----------	Favorable	9,000	Virginia wildrye----------	15
		Normal	8,000	Beaked panicum----------	15
		Unfavorable	6,500	Switchgrass----------	5
				Indiangrass----------	5
				Little bluestem----------	5
				White tridens----------	5
				Panicum----------	5
				Eastern gamagrass----------	5
76*, 77*: Whitewright-------	Chalky Ridge----------	Favorable	4,500	Little bluestem----------	30
		Normal	3,500	Indiangrass----------	15
		Unfavorable	2,000	Big bluestem----------	10
				Sideoats grama----------	10
				Texas needlegrass----------	5
				Silver bluestem----------	5
				Tall dropseed----------	5
Eddy----------	Chalky Ridge----------	Favorable	4,500	Little bluestem----------	30
		Normal	3,500	Indiangrass----------	15
		Unfavorable	2,000	Big bluestem----------	10
				Sideoats grama----------	10
				Texas needlegrass----------	5
				Silver bluestem----------	5
				Hairy grama----------	5
Howe----------	Clay Loam----------	Favorable	6,500	Little bluestem----------	35
		Normal	5,000	Indiangrass----------	15
		Unfavorable	3,000	Big bluestem----------	15
				Sideoats grama----------	5
				Switchgrass----------	5
				Silver bluestem----------	5
				Texas needlegrass----------	5

See footnote at end of table.

TABLE 8.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site	Total production		Characteristic vegetation	Composition
		Kind of year	Dry weight		
			Lb/acre		Pct
78*:					
Whitewright	Chalky Ridge	Favorable	4,500	Little bluestem	30
		Normal	3,500	Indiangrass	15
		Unfavorable	2,000	Big bluestem	10
				Sideoats grama	10
				Texas needlegrass	5
				Silver bluestem	5
				Tall dropseed	5
Gullied land.					
79, 80	Claypan Prairie	Favorable	6,000	Little bluestem	35
Wilson		Normal	4,500	Indiangrass	10
		Unfavorable	3,000	Big bluestem	10
				Virginia wildrye	5
				Vine-mesquite	5
				Florida paspalum	5
				Sideoats grama	5
				Texas needlegrass	5
				Silver bluestem	5
81*	Clayey Bottomland	Favorable	6,000	Virginia wildrye	15
Zilaboy		Normal	5,500	Sedge	10
		Unfavorable	2,500	Beaked panicum	10
				Eastern gamagrass	10
				Canada wildrye	5
				Switchgrass	5
				Indiangrass	5
				Vine-mesquite	5
				Panicum	5
				Buffalograss	5

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--RECREATIONAL DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
1---------- Aledo	Severe: depth to rock.	Moderate: small stones.	Severe: depth to rock, small stones.	Moderate: small stones.
2*---------- Aledo	Severe: slope, depth to rock.	Severe: slope.	Severe: slope, depth to rock, small stones.	Severe: slope.
3---------- Altoga	Moderate: too clayey.	Moderate: too clayey.	Severe: slope.	Moderate: too clayey.
4---------- Aubrey	Slight----------	Slight----------	Severe: slope.	Slight.
5*: Aubrey----------	Moderate: small stones.	Moderate: small stones.	Severe: slope, large stones.	Moderate: large stones.
Birome----------	Moderate: large stones.	Moderate: large stones.	Severe: slope, large stones.	Moderate: large stones.
6*: Aubrey----------	Moderate: small stones.	Moderate: small stones.	Severe: slope, large stones.	Moderate: large stones.
Birome----------	Moderate: large stones.	Moderate: large stones.	Severe: slope, large stones.	Moderate: large stones.
Urban land.				
7*---------- Aubrey	Slight----------	Slight----------	Moderate: slope, depth to rock.	Slight.
8, 9---------- Austin	Moderate: too clayey.	Moderate: too clayey.	Severe: too clayey.	Moderate: too clayey.
10*: Austin----------	Moderate: too clayey.	Moderate: too clayey.	Severe: too clayey.	Moderate: too clayey.
Urban land.				
11---------- Bastrop	Slight----------	Slight----------	Slight----------	Slight.
12---------- Bastrop	Slight----------	Slight----------	Moderate: slope.	Slight.
13---------- Bolar	Moderate: too clayey.	Moderate: too clayey.	Moderate: too clayey.	Moderate: too clayey.
14---------- Bolar	Moderate: too clayey.	Moderate: too clayey.	Severe: slope.	Moderate: too clayey.
15*: Bolar----------	Moderate: large stones.	Moderate: large stones.	Severe: large stones.	Moderate: large stones.

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
15*: Aledo	Severe: depth to rock.	Moderate: small stones.	Severe: slope, depth to rock, small stones.	Moderate: small stones.
16*: Bunyan	Severe: floods.	Moderate: floods.	Severe: floods.	Moderate: floods.
Whitesboro	Severe: floods.	Moderate: floods, wetness.	Severe: floods.	Moderate: floods.
17, 18 Callisburg	Slight	Slight	Moderate: slope.	Slight.
19 Callisburg	Slight	Slight	Severe: slope.	Slight.
20* Callisburg	Slight	Slight	Moderate: slope.	Slight.
21, 22, 23 Crockett	Severe: percs slowly.	Slight	Severe: percs slowly.	Slight.
24*: Crockett	Severe: percs slowly.	Slight	Severe: percs slowly.	Slight.
Urban land.				
25, 26 Crosstell	Severe: percs slowly.	Slight	Severe: percs slowly.	Slight.
27*: Crosstell	Severe: percs slowly.	Slight	Severe: percs slowly.	Slight.
Urban land.				
28 Eddy	Severe: small stones, depth to rock.	Severe: small stones.	Severe: depth to rock, slope, small stones.	Severe: small stones.
29, 30* Elbon	Severe: floods, too clayey.	Severe: floods, too clayey.	Severe: floods, too clayey.	Severe: floods, too clayey.
31*: Fairlie	Severe: too clayey, percs slowly.	Severe: too clayey.	Severe: too clayey, percs slowly.	Severe: too clayey.
Urban land.				
32*, 33*: Fairlie	Severe: too clayey, percs slowly.	Severe: too clayey.	Severe: too clayey, percs slowly.	Severe: too clayey.
Houston Black	Severe: percs slowly, too clayey.	Severe: too clayey.	Severe: percs slowly, too clayey.	Severe: too clayey.
34 Gasil	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
35--- Gasil	Moderate: too sandy.	Moderate: too sandy.	Severe: slope.	Moderate: too sandy.
36*: Gasil---	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.
Urban land.				
37*--- Gasil	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.
38--- Heaton	Moderate: too sandy.	Moderate: too sandy.	Severe: soil blowing, too sandy.	Moderate: too sandy.
39, 40--- Heiden	Severe: too clayey, percs slowly.	Severe: too clayey.	Severe: too clayey, percs slowly.	Severe: too clayey.
41--- Howe	Slight---	Slight---	Severe: slope.	Slight.
42--- Konsil	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.
43--- Konsil	Slight---	Slight---	Moderate: slope.	Slight.
44, 45--- Konsil	Slight---	Slight---	Severe: slope.	Slight.
46, 47--- Lewisville	Moderate: too clayey.	Moderate: too clayey.	Moderate: too clayey, slope.	Moderate: too clayey.
48--- Lindy	Moderate: percs slowly.	Slight---	Moderate: depth to rock.	Slight.
49*: Lindy---	Moderate: percs slowly.	Slight---	Moderate: depth to rock.	Slight.
Urban land.				
50, 51--- Mabank	Severe: wetness.	Moderate: wetness.	Severe: percs slowly, wetness.	Moderate: wetness.
52, 53--- Normangee	Severe: percs slowly.	Moderate: too clayey.	Severe: percs slowly.	Moderate: too clayey.
54*: Normangee---	Severe: percs slowly.	Moderate: too clayey.	Severe: percs slowly.	Moderate: too clayey.
Urban land.				
55*--- Normangee	Severe: percs slowly.	Moderate: too clayey.	Severe: percs slowly.	Moderate: too clayey.
56--- Okay	Slight---	Slight---	Slight---	Slight.
57--- Oklared	Slight---	Slight---	Slight---	Slight.

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
58*:				
Oklared	Severe: floods.	Moderate: floods.	Moderate: floods.	Slight.
Kiomatia	Severe: floods.	Slight	Moderate: floods.	Slight.
59*. Pits				
60 Purves	Severe: too clayey.	Severe: too clayey.	Severe: depth to rock, too clayey.	Severe: too clayey.
61 Redlake	Severe: floods, percs slowly, too clayey.	Severe: too clayey.	Severe: percs slowly, too clayey.	Severe: too clayey.
62, 63 Sanger	Severe: too clayey, percs slowly.	Severe: too clayey.	Severe: too clayey, percs slowly.	Severe: too clayey.
64 Sanger	Severe: too clayey, percs slowly.	Severe: too clayey.	Severe: too clayey, percs slowly, large stones.	Severe: too clayey.
65 Speck Variant	Slight	Slight	Severe: depth to rock.	Slight.
66, 67 Stephen	Moderate: too clayey.	Moderate: too clayey.	Severe: too clayey, depth to rock.	Moderate: too clayey.
68 Trinity	Severe: wetness, floods, percs slowly.	Severe: too clayey.	Severe: wetness, too clayey.	Severe: too clayey.
69*. Urban land				
70, 71 Vertel	Severe: too clayey.	Severe: too clayey.	Severe: too clayey.	Severe: too clayey.
72, 73 Vertel	Severe: too clayey.	Severe: too clayey.	Severe: too clayey, slope.	Severe: too clayey.
74*:				
Vertel	Severe: too clayey.	Severe: too clayey.	Severe: too clayey, slope.	Severe: too clayey.
Urban land.				
75 Whitesboro	Severe: floods.	Moderate: wetness.	Moderate: floods, wetness.	Slight.
76*:				
Whitewright	Slight	Slight	Severe: depth to rock.	Slight.
Eddy	Severe: small stones, depth to rock.	Severe: small stones.	Severe: depth to rock, small stones.	Severe: small stones.

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
76*:				
Howe	Slight	Slight	Moderate: slope, depth to rock, too clayey.	Slight.
77*:				
Whitewright	Moderate: slope.	Moderate: slope.	Severe: depth to rock, slope.	Slight.
Eddy	Severe: small stones, depth to rock.	Severe: small stones.	Severe: depth to rock, slope, small stones.	Severe: small stones.
Howe	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
78*:				
Whitewright	Slight	Slight	Severe: depth to rock, slope.	Slight.
Gullied land.				
79, 80 Wilson	Severe: percs slowly, wetness.	Severe: wetness.	Severe: percs slowly, wetness.	Severe: wetness.
81*				
Zilaboy	Severe: floods, wetness, too clayey.	Severe: too clayey, wetness.	Severe: floods, too clayey, wetness.	Severe: too clayey, wetness.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--WILDLIFE HABITAT

[See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Potential for habitat elements						Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
1----- Aledo	Poor	Poor	Poor	Fair	Very poor	Very poor	Poor	Very poor	Poor.
2*----- Aledo	Very poor	Very poor	Poor	Fair	Very poor	Very poor	Very poor	Very poor	Poor.
3----- Altoga	Fair	Fair	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.
4----- Aubrey	Poor	Fair	Good	Good	Poor	Very poor	Fair	Very poor	Good.
5*:									
Aubrey-----	Very poor	Very poor	Good	Good	Very poor	Very poor	Poor	Very poor	Good.
Birome-----	Very poor	Very poor	Good	Good	Poor	Very poor	Poor	Very poor	Good.
6*:									
Aubrey-----	Very poor	Very poor	Good	Good	Very poor	Very poor	Poor	Very poor	Good.
Birome-----	Very poor	Very poor	Good	Good	Poor	Very poor	Poor	Very poor	Good.
Urban land.									
7*----- Aubrey	Poor	Fair	Good	Good	Poor	Very poor	Fair	Very poor	Good.
8, 9----- Austin	Fair	Good	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.
10*:									
Austin-----	Fair	Good	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.
Urban land.									
11, 12----- Bastrop	Good	Good	Good	Good	Poor	Very poor	Good	Very poor	Good.
13, 14----- Bolar	Fair	Good	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.
15*:									
Bolar-----	Poor	Poor	Fair	Fair	Poor	Very poor	Poor	Very poor	Fair.
Aledo-----	Poor	Poor	Poor	Fair	Very poor	Very poor	Poor	Very poor	Poor.
16*:									
Bunyan-----	Very poor	Poor	Fair	Good	Poor	Very poor	Poor	Very poor	Fair.
Whitesboro-----	Very poor	Poor	Fair	Fair	Poor	Poor	Poor	Poor	Fair.
17----- Callisburg	Good	Good	Good	Good	Poor	Very poor	Good	Very poor	Good.
18----- Callisburg	Fair	Good	Good	Good	Poor	Very poor	Good	Very poor	Good.
19----- Callisburg	Fair	Good	Good	Good	Poor	Very poor	Good	Very poor	Good.
20*----- Callisburg	Poor	Fair	Good	Good	Poor	Very poor	Fair	Very poor	Good.

See footnote at end of table.

TABLE 10.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements						Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
21, 22, 23--------- Crockett	Fair	Good	Good	Good	Poor	Poor	Good	Poor	Good.
24*: Crockett----------	Fair	Good	Good	Good	Poor	Poor	Good	Poor	Good.
Urban land.									
25, 26------------- Crosstell	Fair	Fair	Good	Good	Poor	Very poor	Fair	Very poor	Fair.
27*: Crosstell---------	Fair	Fair	Good	Good	Poor	Very poor	Fair	Very poor	Fair.
Urban land.									
28----------------- Eddy	Poor	Poor	Poor	Fair	Very poor	Very poor	Poor	Very poor	Poor.
29----------------- Elbon	Fair	Fair	Fair	---	Poor	Poor	Fair	Poor	---
30*---------------- Elbon	Poor	Fair	Fair	---	Poor	Poor	Fair	Poor	---
31*: Fairlie----------	Fair	Good	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.
Urban land.									
32*, 33*: Fairlie----------	Good	Good	Fair	Fair	Poor	Poor	Good	Poor	Fair.
Houston Black-----	Good	Good	Poor	Fair	Poor	Poor	Fair	Poor	Fair.
34, 35------------- Gasil	Fair	Good	Good	Good	Very poor	Very poor	Good	Very poor	Good.
36*: Gasil-------------	Fair	Good	Good	Good	Very poor	Very poor	Good	Very poor	Good.
Urban land.									
37*---------------- Gasil	Fair	Good	Good	Good	Very poor	Very poor	Good	Very poor	Good.
38----------------- Heaton	Fair	Good	Good	Good	Poor	Very poor	Good	Very poor	Good.
39----------------- Heiden	Good	Good	Fair	Fair	Poor	Very poor	Good	Very poor	Fair.
40----------------- Heiden	Fair	Good	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.
41----------------- Howe	Fair	Good	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.
42----------------- Konsil	Fair	Good	Good	Good	Very poor	Very poor	Good	Very poor	Good.
43, 44------------- Konsil	Good	Good	Good	Good	Very poor	Very poor	Good	Very poor	Good.
45----------------- Konsil	Poor	Fair	Good	Good	Very poor	Very poor	Fair	Very poor	Good.

See footnote at end of table.

TABLE 10.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements						Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
46---------- Lewisville	Good	Good	Fair	Fair	Poor	Very poor	Good	Very poor	Fair.
47---------- Lewisville	Fair	Good	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.
48---------- Lindy	Fair	Good	Good	Good	Very poor	Very poor	Good	Very poor	Good.
49*: Lindy----------	Fair	Good	Good	Good	Very poor	Very poor	Good	Very poor	Good.
Urban land.									
50, 51---------- Mabank	Fair	Good	Good	Fair	Fair	Fair	Good	Fair	Fair.
52---------- Normangee	Fair	Fair	Fair	Fair	Poor	Poor	Fair	Poor	Fair.
53---------- Normangee	Poor	Fair	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.
54*: Normangee----------	Fair	Fair	Fair	Fair	Poor	Poor	Fair	Poor	Fair.
Urban land.									
55*---------- Normangee	Poor	Fair	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.
56---------- Okay	Good	Good	Good	---	Poor	Very poor	Good	Very poor	---
57---------- Oklared	Good	Good	Good	---	Poor	Very poor	Good	Very poor	---
58*: Oklared----------	Good	Good	Good	---	Poor	Very poor	Good	Very poor	---
Kiomatia----------	Poor	Fair	Fair	---	Poor	Very poor	Fair	Very poor	---
59*. Pits									
60---------- Purves	Fair	Good	Poor	Fair	Poor	Very poor	Fair	Very poor	Poor.
61---------- Redlake	Fair	Fair	Fair	---	Poor	Poor	Fair	Poor	---
62---------- Sanger	Good	Good	Fair	Fair	Poor	Very poor	Good	Very poor	Fair.
63---------- Sanger	Fair	Good	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
64---------- Sanger	Poor	Poor	Fair	Fair	Very poor	Very poor	Poor	Very poor	Fair.
65---------- Speck Variant	Fair	Good	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.
66---------- Stephen	Fair	Good	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.

See footnote at end of table.

TABLE 10.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements						Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
67---------- Stephen	Fair	Good	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.
68---------- Trinity	Fair	Good	Fair	---	Poor	Fair	Fair	Poor	---
69*. Urban land									
70, 71---------- Vertel	Fair	Good	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.
72---------- Vertel	Poor	Fair	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.
73---------- Vertel	Very poor	Very poor	Fair	Fair	Very poor	Very poor	Poor	Very poor	Fair.
74*: Vertel----------	Poor	Fair	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.
Urban land.									
75---------- Whitesboro	Good	Good	Good	Fair	Poor	Poor	Good	Poor	Fair.
76*: Whitewright-------	Fair	Good	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.
Eddy----------	Poor	Poor	Poor	Fair	Very poor	Very poor	Poor	Very poor	Poor.
Howe----------	Fair	Good	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.
77*: Whitewright-------	Poor	Fair	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
Eddy----------	Poor	Poor	Poor	Fair	Very poor	Very poor	Poor	Very poor	Poor.
Howe----------	Poor	Fair	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
78*: Whitewright-------	Poor	Fair	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
Gullied land.									
79, 80---------- Wilson	Fair	Fair	Good	Fair	Fair	Fair	Fair	Fair	Fair.
81*---------- Zilaboy	Poor	Fair	Fair	---	Poor	Good	Fair	Fair	---

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--BUILDING SITE DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
1 Aledo	Severe: depth to rock, cutbanks cave, small stones.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.
2* Aledo	Severe: slope, depth to rock, cutbanks cave.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.
3 Altoga	Severe: too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: low strength, shrink-swell.
4 Aubrey	Severe: too clayey.	Severe: low strength.	Moderate: depth to rock, shrink-swell.	Severe: low strength.	Severe: low strength.
5*: Aubrey	Severe: too clayey.	Severe: low strength.	Moderate: shrink-swell, depth to rock.	Severe: low strength.	Severe: low strength.
Birome	Severe: depth to rock.	Moderate: depth to rock, shrink-swell.	Moderate: depth to rock, shrink-swell.	Severe: depth to rock, large stones.	Severe: low strength.
6*: Aubrey	Severe: too clayey.	Severe: low strength.	Moderate: shrink-swell, depth to rock.	Severe: low strength.	Severe: low strength.
Birome	Severe: depth to rock.	Moderate: depth to rock, shrink-swell.	Moderate: depth to rock, shrink-swell.	Severe: depth to rock, large stones.	Severe: low strength.
Urban land.					
7* Aubrey	Severe: too clayey.	Severe: low strength.	Moderate: depth to rock, shrink-swell.	Severe: low strength.	Severe: low strength.
8, 9 Austin	Severe: too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.
10*: Austin	Severe: too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.
Urban land.					
11, 12 Bastrop	Slight	Slight	Slight	Slight	Moderate: low strength.
13 Bolar	Moderate: depth to rock.	Moderate: low strength.	Moderate: low strength.	Moderate: low strength.	Severe: low strength.
14 Bolar	Moderate: depth to rock.	Moderate: low strength.	Moderate: low strength.	Moderate: low strength, slope.	Severe: low strength.

See footnote at end of table.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
15*:					
Bolar	Moderate: depth to rock.	Moderate: low strength.	Moderate: low strength.	Moderate: low strength, slope.	Severe: low strength.
Aledo	Severe: depth to rock, cutbanks cave, small stones.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.
16*:					
Bunyan	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.
Whitesboro	Severe: floods, wetness.	Severe: floods.	Severe: floods, wetness.	Severe: floods.	Severe: floods, low strength.
17, 18, 19, 20*: Callisburg	Moderate: too clayey.	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.	Severe: low strength, shrink-swell.
21, 22, 23: Crockett	Severe: too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, corrosive, low strength.	Severe: shrink-swell, low strength.
24*:					
Crockett	Severe: too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, corrosive, low strength.	Severe: shrink-swell, low strength.
Urban land.					
25, 26: Crosstell	Severe: too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.
27*:					
Crosstell	Severe: too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.
Urban land.					
28: Eddy	Severe: depth to rock.	Moderate: depth to rock, slope.	Moderate: depth to rock, slope.	Severe: slope.	Moderate: depth to rock, slope.
29: Elbon	Severe: floods.	Severe: floods, shrink-swell, low strength.	Severe: floods, shrink-swell, low strength.	Severe: floods, shrink-swell, low strength.	Severe: low strength, shrink-swell, floods.
30*: Elbon	Severe: floods.	Severe: floods, shrink-swell, low strength.	Severe: floods, shrink-swell, low strength.	Severe: floods, shrink-swell, low strength.	Severe: low strength, shrink-swell, floods.
31*:					
Fairlie	Severe: too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.
Urban land.					

See footnote at end of table.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
32*, 33*: Fairlie	Severe: too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.
Houston Black	Severe: too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.
34--- Gasil	Slight	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.	Severe: low strength.
35--- Gasil	Slight	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.	Moderate: slope, low strength, shrink-swell.	Severe: low strength.
36*: Gasil	Slight	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.	Moderate: slope, low strength, shrink-swell.	Severe: low strength.
Urban land.					
37*--- Gasil	Slight	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.	Severe: low strength.
38--- Heaton	Severe: cutbanks cave.	Slight	Slight	Slight	Slight.
39, 40--- Heiden	Severe: cutbanks cave, too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.
41--- Howe	Moderate: depth to rock.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, depth to rock, low strength.	Moderate: shrink-swell, slope, low strength.	Severe: low strength.
42, 43, 44, 45--- Konsil	Slight	Moderate: low strength.	Moderate: low strength.	Moderate: low strength.	Severe: low strength.
46, 47--- Lewisville	Moderate: too clayey.	Severe: low strength, shrink-swell.	Severe: low strength, shrink-swell.	Severe: low strength, shrink-swell.	Severe: low strength, shrink-swell.
48--- Lindy	Severe: depth to rock, too clayey.	Moderate: shrink-swell, low strength.	Severe: depth to rock.	Moderate: shrink-swell, low strength.	Severe: low strength.
49*: Lindy	Severe: depth to rock, too clayey.	Moderate: shrink-swell, low strength.	Severe: depth to rock.	Moderate: shrink-swell, low strength.	Severe: low strength.
Urban land.					
50, 51--- Mabank	Severe: too clayey, wetness.	Severe: shrink-swell, wetness.	Severe: shrink-swell.	Severe: shrink-swell, wetness, low strength.	Severe: shrink-swell, low strength.
52, 53--- Normangee	Severe: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, corrosive.	Severe: shrink-swell, low strength.

See footnote at end of table.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
54*: Normangee	Severe: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, corrosive.	Severe: shrink-swell, low strength.
Urban land.					
55*---- Normangee	Severe: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, corrosive.	Severe: shrink-swell, low strength.
56---- Okay	Slight----	Slight----	Slight----	Slight----	Moderate: low strength.
57---- Oklared	Moderate: wetness.	Slight----	Moderate: wetness.	Slight----	Moderate: low strength.
58*: Oklared----	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Moderate: low strength, floods.
Kiomatia----	Severe: floods, cutbanks cave.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.
59*. Pits					
60---- Purves	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.
61---- Redlake	Severe: floods, too clayey.	Severe: floods, shrink-swell, low strength.	Severe: floods, shrink-swell, low strength.	Severe: floods, shrink-swell, low strength.	Severe: low strength, shrink-swell.
62, 63, 64---- Sanger	Severe: cutbanks cave, too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.
65---- Speck Variant	Moderate: depth to rock.	Moderate: depth to rock, shrink-swell.	Severe: depth to rock.	Moderate: depth to rock, shrink-swell.	Severe: low strength.
66---- Stephen	Severe: too clayey.	Moderate: depth to rock, shrink-swell.	Moderate: depth to rock, shrink-swell.	Moderate: shrink-swell, depth to rock.	Moderate: depth to rock.
67---- Stephen	Severe: too clayey.	Moderate: depth to rock, shrink-swell.	Moderate: depth to rock, shrink-swell.	Moderate: shrink-swell, depth to rock, slope.	Moderate: depth to rock.
68---- Trinity	Severe: wetness, floods, too clayey.	Severe: floods, shrink-swell, wetness.	Severe: floods, shrink-swell, wetness.	Severe: floods, shrink-swell, wetness.	Severe: shrink-swell.
69*. Urban land					
70, 71, 72, 73---- Vertel	Severe: too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.

See footnote at end of table.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
74*: Vertel	Severe: too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.
Urban land.					
75--- Whitesboro	Severe: floods, wetness.	Severe: floods.	Severe: floods, wetness.	Severe: floods.	Severe: floods, low strength.
76*: Whitewright	Moderate: depth to rock.	Moderate: depth to rock, shrink-swell.	Moderate: depth to rock, shrink-swell.	Moderate: depth to rock, shrink-swell.	Moderate: depth to rock, shrink-swell.
Eddy	Severe: depth to rock.	Moderate: depth to rock.	Moderate: depth to rock.	Moderate: depth to rock.	Moderate: depth to rock.
Howe	Moderate: depth to rock.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, depth to rock, low strength.	Moderate: shrink-swell, slope, low strength.	Severe: low strength.
77*: Whitewright	Moderate: depth to rock, slope.	Moderate: depth to rock, slope, shrink-swell.	Moderate: depth to rock, slope, shrink-swell.	Severe: slope.	Moderate: depth to rock, slope, shrink-swell.
Eddy	Severe: depth to rock.	Moderate: depth to rock, slope.	Moderate: depth to rock, slope.	Severe: slope.	Moderate: depth to rock, slope.
Howe	Moderate: depth to rock, slope.	Moderate: shrink-swell, slope, low strength.	Moderate: slope, depth to rock, low strength.	Severe: slope.	Severe: low strength.
78*: Whitewright	Moderate: depth to rock.	Moderate: depth to rock, shrink-swell.	Moderate: depth to rock, shrink-swell.	Moderate: depth to rock, slope, shrink-swell.	Moderate: depth to rock, shrink-swell.
Gullied land.					
79, 80--- Wilson	Severe: wetness, too clayey.	Severe: shrink-swell, low strength, wetness.	Severe: shrink-swell, low strength, wetness.	Severe: shrink-swell, low strength, wetness.	Severe: shrink-swell, low strength, wetness.
81*--- Zilaboy	Severe: floods, too clayey, wetness.	Severe: floods, shrink-swell, wetness.	Severe: floods, shrink-swell, wetness.	Severe: floods, shrink-swell, wetness.	Severe: shrink-swell, floods, low strength.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--SANITARY FACILITIES

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
1---------- Aledo	Severe: depth to rock.	Severe: depth to rock, small stones.	Severe: depth to rock.	Slight----------	Poor: thin layer, small stones, area reclaim.
2*---------- Aledo	Severe: slope, depth to rock.	Severe: slope, depth to rock, small stones.	Severe: slope, depth to rock.	Severe: slope.	Poor: slope, thin layer, small stones.
3---------- Altoga	Moderate: percs slowly.	Moderate: seepage, slope.	Severe: too clayey.	Slight----------	Fair: too clayey.
4---------- Aubrey	Severe: percs slowly, depth to rock.	Moderate: slope, depth to rock.	Severe: too clayey, depth to rock.	Slight----------	Poor: too clayey, thin layer.
5*: Aubrey----------	Severe: percs slowly, depth to rock.	Severe: slope.	Severe: too clayey, depth to rock.	Slight----------	Poor: too clayey, thin layer.
Birome----------	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock.	Slight----------	Poor: thin layer, large stones.
6*: Aubrey----------	Severe: percs slowly, depth to rock.	Severe: slope.	Severe: too clayey, depth to rock.	Slight----------	Poor: too clayey, thin layer.
Birome----------	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock.	Slight----------	Poor: thin layer, large stones.
Urban land.					
7*---------- Aubrey	Severe: percs slowly, depth to rock.	Moderate: slope, depth to rock.	Severe: too clayey, depth to rock.	Slight----------	Poor: too clayey, thin layer.
8, 9---------- Austin	Severe: percs slowly, depth to rock.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Slight----------	Poor: too clayey.
10*: Austin----------	Severe: percs slowly, depth to rock.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Slight----------	Poor: too clayey.
Urban land.					
11---------- Bastrop	Moderate: percs slowly.	Moderate: seepage.	Slight----------	Slight----------	Good.
12---------- Bastrop	Moderate: percs slowly.	Moderate: seepage, slope.	Slight----------	Slight----------	Good.
13, 14---------- Bolar	Severe: depth to rock.	Severe: depth to rock.	Moderate: depth to rock.	Slight----------	Fair: too clayey.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
15*:					
Bolar	Severe: depth to rock.	Severe: slope, depth to rock.	Moderate: depth to rock.	Slight	Fair: too clayey.
Aledo	Severe: depth to rock.	Severe: slope, depth to rock, small stones.	Severe: depth to rock.	Slight	Poor: thin layer, small stones, area reclaim.
16*:					
Bunyan	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Good.
Whitesboro	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Good.
17, 18--- Callisburg	Moderate: percs slowly.	Moderate: slope.	Moderate: too clayey.	Slight	Fair: too clayey.
19--- Callisburg	Moderate: percs slowly.	Severe: slope.	Moderate: too clayey.	Slight	Fair: too clayey.
20*--- Callisburg	Moderate: percs slowly.	Moderate: slope.	Moderate: too clayey.	Slight	Fair: too clayey.
21--- Crockett	Severe: percs slowly.	Slight	Severe: too clayey.	Slight	Poor: too clayey.
22, 23--- Crockett	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey.
24*:					
Crockett	Severe: percs slowly.	Slight	Severe: too clayey.	Slight	Poor: too clayey.
Urban land.					
25, 26--- Crosstell	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey.
27*:					
Crosstell	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey.
Urban land.					
28--- Eddy	Severe: depth to rock.	Severe: depth to rock, slope, small stones.	Severe: depth to rock.	Moderate: slope.	Poor: area reclaim, small stones.
29--- Elbon	Severe: floods, percs slowly, wetness.	Severe: wetness, floods.	Severe: floods.	Severe: wetness.	Fair: too clayey.
30*--- Elbon	Severe: floods, percs slowly, wetness.	Severe: wetness, floods.	Severe: floods.	Severe: wetness.	Fair: too clayey.
31*:					
Fairlie	Severe: percs slowly, depth to rock.	Moderate: slope, depth to rock.	Severe: too clayey, depth to rock.	Slight	Poor: too clayey.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for l...
31*: Urban land.					
32*: Fairlie	Severe: percs slowly, depth to rock.	Moderate: depth to rock.	Severe: too clayey, depth to rock.	Slight	Poor: too clayey.
Houston Black	Severe: percs slowly.	Slight	Severe: too clayey.	Slight	Poor: too clayey.
33*: Fairlie	Severe: percs slowly, depth to rock.	Moderate: slope, depth to rock.	Severe: too clayey, depth to rock.	Slight	Poor: too clayey.
Houston Black	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey.
34, 35--- Gasil	Moderate: percs slowly.	Moderate: seepage.	Slight	Slight	Fair: too sandy.
36*: Gasil	Moderate: percs slowly.	Moderate: seepage.	Slight	Slight	Fair: too sandy.
Urban land.					
37*--- Gasil	Moderate: percs slowly.	Moderate: seepage.	Slight	Slight	Fair: too sandy.
38--- Heaton	Moderate: percs slowly.	Moderate: seepage.	Slight	Slight	Fair: too sandy.
39, 40--- Heiden	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey.
41--- Howe	Severe: depth to rock.	Moderate: depth to rock, slope, seepage.	Severe: depth to rock.	Slight	Fair: thin layer, too clayey.
42--- Konsil	Moderate: percs slowly.	Moderate: seepage.	Slight	Slight	Fair: too sandy.
43, 44, 45--- Konsil	Moderate: percs slowly.	Moderate: seepage.	Slight	Slight	Good.
46, 47--- Lewisville	Moderate: percs slowly.	Moderate: seepage.	Severe: too clayey.	Slight	Fair: too clayey.
48--- Lindy	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock.	Slight	Fair: thin layer, too clayey.
49*: Lindy	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock.	Slight	Fair: thin layer, too clayey.
Urban land.					
50--- Mabank	Severe: percs slowly, wetness.	Slight	Severe: too clayey.	Severe: wetness.	Poor: too clayey.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
51---------- Mabank	Severe: percs slowly, wetness.	Moderate: slope.	Severe: too clayey.	Severe: wetness.	Poor: too clayey.
52, 53---------- Normangee	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight----------	Poor: too clayey.
54*: Normangee----------	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight----------	Poor: too clayey.
Urban land.					
55*---------- Normangee	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight----------	Poor: too clayey.
56---------- Okay	Slight----------	Severe: seepage.	Severe: seepage.	Slight----------	Good.
57---------- Oklared	Severe: wetness.	Severe: wetness, seepage.	Severe: seepage.	Severe: seepage.	Good.
58*: Oklared----------	Severe: wetness, floods.	Severe: wetness, seepage, floods.	Severe: seepage, floods.	Severe: floods, seepage.	Good.
Kiomatia----------	Severe: floods, wetness.	Severe: floods, seepage.	Severe: floods, seepage, wetness.	Severe: floods, seepage, wetness.	Fair: too sandy.
59*. Pits					
60---------- Purves	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock.	Slight----------	Poor: thin layer, too clayey.
61---------- Redlake	Severe: percs slowly, floods.	Severe: floods.	Severe: floods, too clayey.	Severe: floods.	Poor: hard to pack, too clayey.
62, 63---------- Sanger	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight----------	Poor: too clayey.
64---------- Sanger	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight----------	Poor: too clayey, large stones.
65---------- Speck Variant	Severe: depth to rock, percs slowly.	Moderate: depth to rock, slope.	Severe: depth to rock.	Slight----------	Poor: thin layer, area reclaim.
66, 67---------- Stephen	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight----------	Poor: thin layer, too clayey.
68---------- Trinity	Severe: wetness, floods, percs slowly.	Severe: wetness.	Severe: floods, too clayey, wetness.	Severe: floods, wetness.	Poor: too clayey.
69*. Urban land					

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
70, 71--- Vertel	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight---	Poor: too clayey, hard to pack.
72--- Vertel	Severe: percs slowly.	Severe: slope.	Severe: too clayey.	Moderate: slope.	Poor: too clayey, hard to pack.
73--- Vertel	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight---	Poor: too clayey, hard to pack.
74*: Vertel---	Severe: percs slowly.	Severe: slope.	Severe: too clayey.	Moderate: slope.	Poor: too clayey, hard to pack.
Urban land.					
75--- Whitesboro	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Good.
76*: Whitewright---	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe---	Poor: thin layer, area reclaim.
Eddy---	Severe: depth to rock.	Severe: depth to rock, small stones.	Severe: depth to rock.	Slight---	Poor: area reclaim, small stones.
Howe---	Severe: depth to rock.	Moderate: depth to rock, slope, seepage.	Severe: depth to rock.	Slight---	Fair: thin layer, too clayey.
77*: Whitewright---	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.	Severe---	Poor: thin layer, area reclaim.
Eddy---	Severe: depth to rock.	Severe: depth to rock, slope, small stones.	Severe: depth to rock.	Moderate: slope.	Poor: area reclaim, small stones.
Howe---	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Moderate: slope.	Fair: slope, thin layer, too clayey.
78*: Whitewright---	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.	Severe---	Poor: thin layer, area reclaim.
Gullied land.					
79--- Wilson	Severe: percs slowly, wetness.	Slight---	Severe: too clayey, wetness.	Severe: wetness.	Poor: thin layer, wetness.
80--- Wilson	Severe: percs slowly, wetness.	Moderate: slope.	Severe: too clayey, wetness.	Severe: wetness.	Poor: thin layer, wetness.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
81*---------- Zilaboy	Severe: floods, wetness, percs slowly.	Severe: floods, wetness.	Severe: floods, wetness, too clayey.	Severe: floods, wetness.	Poor: too clayey, wetness.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--CONSTRUCTION MATERIALS

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," and "poor." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
1---------- Aledo	Poor: thin layer, area reclaim.	Unsuited: excess fines.	Poor: excess fines, thin layer.	Poor: small stones, area reclaim.
2*---------- Aledo	Poor: slope, thin layer, area reclaim.	Unsuited: excess fines.	Poor: excess fines, thin layer.	Poor: slope, small stones, area reclaim.
3---------- Altoga	Poor: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey.
4---------- Aubrey	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: thin layer.
5*: Aubrey----------	Poor: low strength.	Poor: excess fines.	Unsuited: excess fines.	Poor: thin layer, large stones.
Birome----------	Poor: thin layer, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: thin layer, large stones.
6*: Aubrey----------	Poor: low strength.	Poor: excess fines.	Unsuited: excess fines.	Poor: thin layer, large stones.
Birome----------	Poor: thin layer, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: thin layer, large stones.
Urban land.				
7*---------- Aubrey	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: thin layer.
8, 9---------- Austin	Poor: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: too clayey.
10*: Austin----------	Poor: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: too clayey.
Urban land.				
11, 12---------- Bastrop	Fair: low strength.	Poor: excess fines.	Unsuited: excess fines.	Good.
13, 14---------- Bolar	Poor: low strength, thin layer.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: excess lime.
15*: Bolar----------	Poor: low strength, thin layer.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: large stones.

See footnote at end of table.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
15*:				
Aledo	Poor: thin layer, area reclaim.	Unsuited: excess fines.	Poor: excess fines, thin layer.	Poor: small stones, area reclaim.
16*:				
Bunyan	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
Whitesboro	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
17, 18, 19, 20*: Callisburg	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
21, 22, 23: Crockett	Poor: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: thin layer.
24*:				
Crockett	Poor: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: thin layer.
Urban land.				
25, 26: Crosstell	Poor: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: thin layer.
27*:				
Crosstell	Poor: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: thin layer.
Urban land.				
28: Eddy	Fair: thin layer, area reclaim.	Unsuited: excess fines.	Poor: excess fines, small stones.	Poor: thin layer, excess lime, small stones.
29, 30*: Elbon	Poor: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey.
31*:				
Fairlie	Poor: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: too clayey.
Urban land.				
32*, 33*:				
Fairlie	Poor: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: too clayey.
Houston Black	Poor: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: too clayey.
34, 35: Gasil	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too sandy.
36*:				
Gasil	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too sandy.

See footnote at end of table.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
36*: Urban land.				
37*---- Gasil	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too sandy.
38---- Heaton	Good----	Poor: excess fines.	Unsuited: excess fines.	Fair: too sandy.
39, 40---- Heiden	Poor: shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: too clayey.
41---- Howe	Poor: low strength, thin layer.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: excess lime.
42---- Konsil	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: too sandy.
43, 44, 45---- Konsil	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
46, 47---- Lewisville	Poor: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: too clayey.
48---- Lindy	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey.
49*: Lindy----	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey.
Urban land.				
50, 51---- Mabank	Poor: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: too clayey.
52, 53---- Normangee	Poor: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: too clayey.
54*: Normangee----	Poor: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: too clayey.
Urban land.				
55*---- Normangee	Poor: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: too clayey.
56---- Okay	Good----	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
57---- Oklared	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
58*: Oklared----	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
Kiomatia----	Good----	Poor: excess fines.	Unsuited: excess fines.	Poor: too sandy.

See footnote at end of table.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
59*. Pits				
60---------- Purves	Poor: shrink-swell, thin layer.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: too clayey, thin layer.
61---------- Redlake	Poor: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: too clayey.
62, 63---------- Sanger	Poor: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: too clayey.
64---------- Sanger	Poor: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: too clayey, large stones.
65---------- Speck Variant	Poor: area reclaim, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: thin layer.
66, 67---------- Stephen	Poor: thin layer, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: too clayey.
68---------- Trinity	Poor: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: too clayey.
69*. Urban land				
70, 71, 72, 73-------- Vertel	Poor: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: too clayey.
74*: Vertel----------	Poor: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: too clayey.
Urban land.				
75---------- Whitesboro	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
76*, 77*: Whitewright----------	Poor: thin layer, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: excess lime, area reclaim.
Eddy----------	Fair: thin layer, area reclaim.	Unsuited: excess fines.	Poor: excess fines, small stones.	Poor: thin layer, excess lime, small stones.
Howe----------	Poor: low strength, thin layer.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: excess lime.
78*: Whitewright----------	Poor: thin layer, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: excess lime, area reclaim.
Gullied land.				

See footnote at end of table.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
79, 80---------- Wilson	Poor: shrink-swell, low strength, wetness.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: thin layer, wetness.
81*---------- Zilaboy	Poor: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: too clayey, wetness.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--WATER MANAGEMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated]

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
1, 2* Aledo	Severe: depth to rock.	Severe: thin layer.	Not needed	Rooting depth, droughty, slope.	Depth to rock, small stones, slope.	Droughty, rooting depth.
3 Altoga	Moderate: seepage.	Moderate: unstable fill.	Not needed	Complex slope, erodes easily.	Favorable	Favorable.
4 Aubrey	Slight	Moderate: thin layer, hard to pack.	Not needed	Slow intake, soil blowing, percs slowly.	Slope, depth to rock, soil blowing.	Percs slowly.
5*: Aubrey	Slight	Moderate: thin layer, hard to pack.	Not needed	Slow intake, large stones, percs slowly.	Large stones, slope.	Large stones, slope, depth to rock.
Birome	Severe: depth to rock.	Severe: large stones.	Not needed	Complex slope, large stones.	Large stones	Large stones.
6*: Aubrey	Slight	Moderate: thin layer, hard to pack.	Not needed	Slow intake, large stones, percs slowly.	Large stones, slope.	Large stones, slope, depth to rock.
Birome	Severe: depth to rock.	Severe: large stones.	Not needed	Complex slope, large stones.	Large stones	Large stones.
Urban land.						
7* Aubrey	Slight	Moderate: thin layer, hard to pack.	Not needed	Slow intake, soil blowing, percs slowly.	Slope, depth to rock, soil blowing.	Percs slowly.
8, 9 Austin	Moderate: depth to rock.	Moderate: hard to pack.	Not needed	Slow intake, rooting depth, slope.	Depth to rock	Depth to rock.
10*: Austin	Moderate: depth to rock.	Moderate: hard to pack.	Not needed	Slow intake, rooting depth, slope.	Depth to rock	Depth to rock.
Urban land.						
11, 12 Bastrop	Moderate: seepage.	Slight	Not needed	Fast intake, soil blowing, slope.	Soil blowing	Erodes easily.
13 Bolar	Severe: seepage.	Moderate: thin layer.	Depth to rock	Excess lime	Favorable	Favorable.
14 Bolar	Severe: seepage.	Moderate: thin layer.	Depth to rock	Excess lime	Slope	Favorable.
15*: Bolar	Severe: seepage.	Moderate: thin layer.	Depth to rock	Excess lime	Large stones	Large stones.
Aledo	Severe: depth to rock.	Severe: thin layer.	Not needed	Rooting depth, droughty, slope.	Depth to rock, small stones, slope.	Droughty, rooting depth.
16*: Bunyan	Moderate: seepage.	Moderate: piping.	Not needed	Floods	Not needed	Favorable.

See footnote at end of table.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
16*: Whitesboro	Moderate: seepage.	Moderate: wetness.	Floods, wetness.	Floods, wetness.	Not needed	Favorable.
17, 18, 19, 20*: Callisburg	Slight	Slight	Not needed	Percs slowly	Favorable	Favorable.
21, 22, 23: Crockett	Slight	Moderate: unstable fill, compressible.	Not needed	Percs slowly, rooting depth, erodes easily.	Percs slowly, erodes easily.	Percs slowly, erodes easily.
24*: Crockett	Slight	Moderate: unstable fill, compressible.	Not needed	Percs slowly, rooting depth, erodes easily.	Percs slowly, erodes easily.	Percs slowly, erodes easily.
Urban land.						
25, 26: Crosstell	Slight	Moderate: unstable fill.	Not needed	Slow intake, percs slowly.	Percs slowly, slow intake.	Percs slowly.
27*: Crosstell	Slight	Moderate: unstable fill.	Not needed	Slow intake, percs slowly.	Percs slowly, slow intake.	Percs slowly.
Urban land.						
28: Eddy	Severe: depth to rock.	Severe: thin layer.	Not needed	Rooting depth, droughty, slope.	Depth to rock, small stones.	Droughty, rooting depth, slope.
29, 30*: Elbon	Slight	Moderate: compressible, unstable fill.	Floods, percs slowly.	Floods, slow intake.	Not needed	Not needed.
31*: Fairlie	Moderate: depth to rock.	Moderate: hard to pack, unstable fill.	Not needed	Slow intake, percs slowly.	Percs slowly	Percs slowly.
Urban land.						
32*, 33*: Fairlie	Moderate: depth to rock.	Moderate: hard to pack, unstable fill.	Not needed	Slow intake, percs slowly.	Percs slowly	Percs slowly.
Houston Black	Slight	Moderate: compressible, unstable fill.	Percs slowly	Slow intake	Percs slowly	Percs slowly.
34, 35: Gasil	Moderate: seepage.	Slight	Not needed	Fast intake	Favorable	Favorable.
36*: Gasil	Moderate: seepage.	Slight	Not needed	Fast intake	Favorable	Favorable.
Urban land.						
37*: Gasil	Moderate: seepage.	Slight	Not needed	Fast intake	Favorable	Favorable.
38: Heaton	Severe: seepage.	Moderate: erodes easily, thin layer.	Not needed	Fast intake, soil blowing, droughty.	Too sandy, erodes easily, soil blowing.	Droughty, erodes easily.
39, 40: Heiden	Slight	Moderate: unstable fill, shrink-swell.	Not needed	Slow intake	Percs slowly	Percs slowly.

See footnote at end of table.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
41---------- Howe	Severe: seepage.	Moderate: thin layer.	Not needed-----	Slope, rooting depth.	Favorable------	Depth to rock.
42, 43, 44, 45---- Konsil	Moderate: seepage.	Moderate: piping.	Not needed-----	Erodes easily	Favorable------	Favorable.
46, 47---------- Lewisville	Moderate: seepage.	Moderate: unstable fill.	Favorable------	Favorable------	Favorable------	Favorable.
48---------- Lindy	Severe: depth to rock.	Moderate: piping, thin layer.	Not needed-----	Rooting depth, slow intake.	Rooting depth	Rooting depth.
49*: Lindy----------	Severe: depth to rock.	Moderate: piping, thin layer.	Not needed-----	Rooting depth, slow intake.	Rooting depth	Rooting depth.
Urban land.						
50, 51---------- Mabank	Slight---------	Moderate: unstable fill.	Percs slowly---	Slow intake, percs slowly.	Percs slowly---	Percs slowly.
52, 53---------- Normangee	Slight---------	Moderate: unstable fill.	Not needed-----	Percs slowly, slow intake, erodes easily.	Slow intake, erodes easily, percs slowly.	Percs slowly, erodes easily.
54*: Normangee--------	Slight---------	Moderate: unstable fill.	Not needed-----	Percs slowly, slow intake, erodes easily.	Slow intake, erodes easily, percs slowly.	Percs slowly, erodes easily.
Urban land.						
55*---------- Normangee	Slight---------	Moderate: unstable fill.	Not needed-----	Percs slowly, slow intake, erodes easily.	Slow intake, erodes easily, percs slowly.	Percs slowly, erodes easily.
56---------- Okay	Severe: seepage.	Moderate: unstable fill, piping.	Not needed-----	Favorable------	Favorable------	Favorable.
57---------- Oklared	Severe: seepage.	Moderate: unstable fill, piping.	Not needed-----	Favorable------	Not needed-----	Not needed.
58*: Oklared----------	Severe: seepage.	Moderate: unstable fill, piping.	Not needed-----	Floods---------	Not needed-----	Not needed.
Kiomatia---------	Severe: seepage.	Severe: piping.	Floods---------	Droughty, floods, fast intake.	Favorable------	Droughty.
59*. Pits						
60---------- Purves	Severe: depth to rock.	Severe: thin layer.	Depth to rock	Droughty, rooting depth.	Depth to rock	Rooting depth, droughty.
61---------- Redlake	Slight---------	Moderate: unstable fill, compressible.	Floods, percs slowly.	Slow intake, floods.	Percs slowly---	Percs slowly.
62, 63---------- Sanger	Slight---------	Moderate: unstable fill, compressible.	Slope, percs slowly.	Slow intake----	Percs slowly---	Percs slowly, slope.

See footnote at end of table.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
64---------- Sanger	Slight---------	Moderate: unstable fill, low strength.	Not needed-----	Slow intake, slope.	Large stones, slope, percs slowly.	Percs slowly, slope, large stones.
65---------- Speck Variant	Severe: depth to rock.	Severe: thin layer.	Not needed-----	Percs slowly, rooting depth.	Depth to rock, percs slowly.	Rooting depth, percs slowly.
66, 67---------- Stephen	Severe: depth to rock.	Severe: thin layer.	Not needed-----	Slope, rooting depth, slow intake.	Depth to rock, rooting depth.	Rooting depth, depth to rock.
68---------- Trinity	Slight---------	Moderate: compressible, unstable fill.	Percs slowly, floods.	Percs slowly, wetness.	Floods, wetness, percs slowly.	Wetness, percs slowly.
69*. Urban land						
70, 71, 72, 73---- Vertel	Slight---------	Moderate: compressible, unstable fill.	Not needed-----	Percs slowly, slope.	Percs slowly---	Percs slowly.
74*: Vertel----------	Slight---------	Moderate: compressible, unstable fill.	Not needed-----	Percs slowly, slope.	Percs slowly---	Percs slowly.
Urban land.						
75---------- Whitesboro	Moderate: seepage.	Moderate: wetness.	Floods, wetness.	Floods, wetness.	Not needed-----	Favorable.
76*: Whitewright------	Severe: depth to rock.	Severe: thin layer.	Not needed-----	Rooting depth, slope.	Depth to rock	Rooting depth, depth to rock.
Eddy----------	Severe: depth to rock.	Severe: thin layer.	Not needed-----	Rooting depth, droughty, slope.	Depth to rock, small stones.	Droughty, rooting depth, slope.
Howe----------	Severe: seepage.	Moderate: thin layer.	Not needed-----	Slope, rooting depth.	Favorable------	Depth to rock.
77*: Whitewright------	Severe: depth to rock.	Severe: thin layer.	Not needed-----	Rooting depth, slope.	Depth to rock, slope.	Rooting depth, slope, depth to rock.
Eddy----------	Severe: depth to rock.	Severe: thin layer.	Not needed-----	Rooting depth, droughty, slope.	Depth to rock, small stones.	Droughty, rooting depth, slope.
Howe----------	Severe: seepage.	Moderate: thin layer.	Not needed-----	Slope, rooting depth.	Favorable------	Slope, depth to rock.
78*: Whitewright------	Severe: depth to rock.	Severe: thin layer.	Not needed-----	Rooting depth, slope.	Depth to rock	Rooting depth, depth to rock.
Gullied land.						
79, 80---------- Wilson	Slight---------	Severe: wetness.	Percs slowly---	Percs slowly, slow intake, wetness.	Percs slowly, wetness.	Percs slowly, wetness.
81*---------- Zilaboy	Slight---------	Moderate: hard to pack, wetness.	Floods, percs slowly.	Slow intake, percs slowly, wetness.	Not needed-----	Percs slowly, wetness.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--ENGINEERING INDEX PROPERTIES

[The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated]

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
1---------- Aledo	0-3	Gravelly clay loam.	CL, GC, SC	A-4, A-6	0-20	65-95	60-90	55-90	40-70	30-40	8-20
	3-8	Very gravelly clay loam, very gravelly loam.	GC, SC	A-2-4, A-2-6	5-30	35-65	30-50	25-50	15-35	30-40	8-20
	8-12	Weathered bedrock.	---	---	---	---	---	---	---	---	---
2*---------- Aledo	0-8	Very gravelly clay loam, very gravelly loam.	GC, SC	A-2-4, A-2-6	5-30	35-65	30-50	25-50	15-35	30-40	8-20
	8-12	Weathered bedrock.	---	---	---	---	---	---	---	---	---
3---------- Altoga	0-32	Clay loam-------	CL, CH	A-6, A-7-6	0	95-100	95-100	90-100	80-99	35-51	20-31
	32-65	Silty clay, silty clay loam, clay loam.	CL	A-6, A-7-6	0	95-100	95-100	90-100	65-99	30-48	15-30
4---------- Aubrey	0-4	Fine sandy loam	ML, SM, CL-ML, SM-SC	A-4, A-2-4	0	95-100	90-100	70-90	20-55	<25	NP-7
	4-26	Clay----------	CL, CH	A-7-6	0	95-100	95-100	90-100	51-85	41-60	20-38
	26-50	Weathered bedrock.	---	---	---	---	---	---	---	---	---
5*:											
Aubrey----------	0-6	Stony fine sandy loam.	SM, SM-SC, CL-ML, ML	A-4, A-2-4	5-40	85-100	85-100	60-85	20-55	<25	NP-7
	6-32	Clay----------	CL, CH	A-7-6	0	95-100	95-100	90-100	51-75	41-60	20-38
	32-60	Weathered bedrock.	---	---	---	---	---	---	---	---	---
Birome----------	0-8	Stony fine sandy loam.	SM, SM-SC, CL-ML, ML	A-4, A-2-4	2-15	75-90	75-90	55-90	30-55	<30	NP-7
	8-25	Clay, sandy clay	CL, CH	A-6, A-7	0-2	80-100	80-100	70-100	51-75	35-55	15-35
	25-31	Clay, sandy clay, clay loam.	CL, SC	A-6, A-7	2-30	70-100	60-100	50-70	40-60	30-45	15-25
	31-35	Stratified unweathered bedrock to weathered bedrock.	---	---	---	---	---	---	---	---	---
6*:											
Aubrey----------	0-6	Stony fine sandy loam.	SM, SM-SC, CL-ML, ML	A-4, A-2-4	5-40	85-100	85-100	60-85	20-55	<25	NP-7
	6-32	Clay----------	CL, CH	A-7-6	0	95-100	95-100	90-100	51-75	41-60	20-38
	32-60	Weathered bedrock.	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
6*:											
Birome	0-8	Stony fine sandy loam.	SM, SM-SC, CL-ML, ML	A-4, A-2-4	2-15	75-90	75-90	55-90	30-55	<30	NP-7
	8-25	Clay, sandy clay	CL, CH	A-6, A-7	0-2	80-100	80-100	70-100	51-75	35-55	15-35
	25-31	Clay, sandy clay, clay loam.	CL, SC	A-6, A-7	2-30	70-100	60-100	50-70	40-60	30-45	15-25
	31-35	Stratified unweathered bedrock to weathered bedrock.	---	---	---	---	---	---	---	---	---
Urban land.											
7* Aubrey	0-4	Fine sandy loam	ML, SM, CL-ML, SM-SC	A-4, A-2-4	0	95-100	90-100	70-90	20-55	<25	NP-7
	4-26	Clay	CL, CH	A-7-6	0	95-100	95-100	90-100	51-85	41-60	20-38
	26-50	Weathered bedrock.	---	---	---	---	---	---	---	---	---
8, 9 Austin	0-11	Silty clay	CH, CL	A-7-6	0-5	95-100	90-100	80-100	75-95	45-65	25-40
	11-30	Silty clay, clay, silty clay loam.	CH, CL	A-7-6	0-5	95-100	90-100	80-100	75-95	45-65	22-38
	30-36	Weathered bedrock.	---	---	---	---	---	---	---	---	---
10*:											
Austin	0-11	Silty clay	CH, CL	A-7-6	0-5	95-100	90-100	80-100	75-95	45-65	25-40
	11-30	Silty clay, clay, silty clay loam.	CH, CL	A-7-6	0-5	95-100	90-100	80-100	75-95	45-65	22-38
	30-36	Weathered bedrock.	---	---	---	---	---	---	---	---	---
Urban land.											
11, 12 Bastrop	0-6	Loam	ML, SM, CL-ML, SM-SC	A-4	0	95-100	80-100	80-100	36-70	18-25	2-7
	6-62	Sandy clay loam, clay loam, loam.	CL, SC	A-6	0	95-100	80-100	80-100	40-70	26-40	11-22
13, 14 Bolar	0-10	Clay loam	CL, SC	A-6, A-7, A-4	0-5	75-100	75-100	70-98	40-80	25-42	9-25
	10-37	Clay loam, loam, silty clay loam.	CL, SC	A-6, A-7	0-10	75-95	75-95	70-90	40-75	25-42	11-25
	37-40	Weathered bedrock.	---	---	---	---	---	---	---	---	---
15*: Bolar	0-9	Stony clay loam	CL, SC	A-6, A-7, A-4	8-20	75-90	75-90	70-85	36-65	25-42	9-25
	9-26	Clay loam, loam, silty clay loam.	CL, SC	A-6, A-7	0-10	75-95	75-95	70-90	40-75	25-42	11-25
	26-28	Weathered bedrock.	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
15*:											
Aledo	0-8	Very gravelly clay loam, very gravelly loam.	GC, SC	A-2-4, A-2-6	5-30	35-65	30-50	25-50	15-35	30-40	8-20
	8-10	Weathered bedrock.	---	---	---	---	---	---	---	---	---
16*:											
Bunyan	0-22	Fine sandy loam	SM-SC, SC, CL, CL-ML	A-4, A-6	0	100	95-100	70-95	40-75	20-35	3-16
	22-48	Stratified clay loam to fine sandy loam.	SC, CL, ML	A-4, A-6	0	100	95-100	80-100	40-95	20-40	8-25
	48-65	Stratified clay loam to fine sandy loam.	SC, CL, ML	A-6, A-7	0	100	95-100	80-95	45-95	30-45	11-25
Whitesboro	0-27	Loam	CL	A-6, A-7-6	0	100	98-100	85-100	60-80	30-43	11-24
	27-72	Loam, clay loam, sandy clay loam.	CL	A-6, A-7-6	0	100	98-100	85-100	60-85	30-45	11-25
17, 18, 19, 20*-- Callisburg	0-5	Fine sandy loam	CL, ML, SM, SC	A-4	0	95-100	90-100	75-100	36-75	<25	NP-8
	5-16	Sandy clay loam, sandy clay, clay.	CL, SC	A-6, A-7	0	95-100	90-100	85-100	40-90	30-48	12-28
	16-62	Sandy clay, clay	CL	A-6, A-7	0	90-100	85-100	80-99	51-80	30-50	12-28
21, 22, 23--- Crockett	0-4	Loam	SM, ML, CL, SC	A-2, A-4, A-6	0-2	95-100	95-100	90-100	35-98	15-35	3-15
	4-65	Clay, clay loam, sandy clay.	CH, CL	A-7, A-6	0	85-100	80-100	75-100	65-98	36-60	22-45
24*:											
Crockett	0-4	Loam	SM, ML, CL, SC	A-2, A-4, A-6	0-2	95-100	95-100	90-100	35-98	15-35	3-15
	4-65	Clay, clay loam, sandy clay.	CH, CL	A-7, A-6	0	85-100	80-100	75-100	65-98	36-60	22-45
Urban land.											
25, 26--- Crosstell	0-3	Fine sandy loam	SM, ML, SM-SC, CL-ML	A-2-4, A-4	0	85-100	85-100	75-95	28-60	<31	NP-7
	3-43	Clay	CH, CL	A-7-6	0	80-100	80-100	75-98	51-75	42-60	25-40
	43-60	Stratified clay to weathered bedrock.	CH, CL, SC	A-7-6, A-6	0	80-100	80-98	70-95	36-88	35-55	15-35
27*:											
Crosstell	0-3	Fine sandy loam	SM, ML, SM-SC, CL-ML	A-2-4, A-4	0	85-100	85-100	75-95	28-60	<31	NP-7
	3-43	Clay	CH, CL	A-7-6	0	80-100	80-100	75-98	51-75	42-60	25-40
	43-60	Stratified clay to weathered bedrock.	CH, CL, SC	A-7-6, A-6	0	80-100	80-98	70-95	36-88	35-55	15-35
Urban land.											

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
28---------- Eddy	0-5	Gravelly clay loam.	GC	A-2, A-6	0-20	40-50	35-50	30-45	20-40	30-40	11-20
	5-13	Gravelly clay loam, very gravelly loam, very gravelly clay loam.	GC, GP-GC	A-2	0-60	20-50	15-45	10-38	8-35	30-40	11-20
	13-16	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
29, 30*---------- Elbon	0-23	Clay----------	CL, CH	A-7	0	100	100	95-100	85-100	45-60	23-35
	23-65	Stratified silty clay loam to clay.	CL, CH	A-7, A-6	0	100	100	85-98	80-95	35-55	18-35
31*: Fairlie----------	0-5	Clay----------	CH, CL	A-7	0	95-100	95-100	90-100	85-100	41-60	25-40
	5-46	Silty clay loam, silty clay, clay.	CH	A-7	0	95-100	95-100	90-100	85-100	51-80	28-50
	46-55	Weathered bedrock.	---	---	---	---	---	---	---	---	---
Urban land.											
32*, 33*: Fairlie----------	0-5	Clay----------	CH, CL	A-7	0	95-100	95-100	90-100	85-100	41-60	25-40
	5-46	Silty clay loam, silty clay, clay.	CH	A-7	0	95-100	95-100	90-100	85-100	51-80	28-50
	46-55	Weathered bedrock.	---	---	---	---	---	---	---	---	---
Houston Black-----	0-17	Clay----------	CH	A-7-6	0	95-100	95-100	95-100	85-100	58-98	34-72
	17-65	Clay, silty clay	CH	A-7-6	0	95-100	95-100	95-100	85-100	58-100	34-75
34, 35---------- Gasil	0-10	Loamy fine sand	SM, SM-SC	A-2-4, A-4	0	95-100	92-99	50-75	20-40	<20	NP-4
	10-66	Sandy clay loam, loam, fine sandy loam.	CL, SC, CL-ML, SM-SC	A-6, A-4	0	95-100	92-100	85-100	36-71	22-40	7-20
36*: Gasil----------	0-10	Loamy fine sand	SM, SM-SC	A-2-4, A-4	0	95-100	92-99	50-75	20-40	<20	NP-4
	10-66	Sandy clay loam, loam, fine sandy loam.	CL, SC, CL-ML, SM-SC	A-6, A-4	0	95-100	92-100	85-100	36-71	22-40	7-20
Urban land.											
37*---------- Gasil	0-10	Loamy fine sand	SM, SM-SC	A-2-4, A-4	0	95-100	92-99	50-75	20-40	<20	NP-4
	10-66	Sandy clay loam, loam, fine sandy loam.	CL, SC, CL-ML, SM-SC	A-6, A-4	0	95-100	92-100	85-100	36-71	22-40	7-20
38---------- Heaton	0-28	Loamy fine sand	SM	A-2-4	0	95-100	95-100	70-90	15-30	<25	NP-3
	28-53	Sandy clay loam	SC, SM-SC	A-2-4, A-4, A-6, A-2-6	0	98-100	95-100	75-90	25-45	20-35	4-15
	53-65	Sandy clay loam, fine sandy loam.	SC, SM-SC	A-2-4, A-4, A-6, A-2-6	0	98-100	95-100	75-90	25-45	20-35	4-15
39, 40---------- Heiden	0-14	Clay----------	CH	A-7-6	0	95-100	90-100	80-100	75-99	54-80	35-55
	14-60	Clay, silty clay	CH	A-7-6	0	90-100	90-100	75-100	70-99	52-80	35-55

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
41---------- Howe	0-7	Silty clay loam	CL, CH	A-7-6, A-6	0	95-100	95-100	85-100	55-90	35-52	15-30
	7-26	Silty clay loam, clay loam, silty clay.	CL, CH	A-7-6, A-6	0	95-100	90-100	85-100	65-95	35-52	15-30
	26-32	Weathered bedrock.	---	---	---	---	---	---	---	---	---
42---------- Konsil	0-11	Loamy fine sand	SM, SM-SC	A-2, A-4	0	90-100	90-99	50-75	20-40	<25	NP-4
	11-65	Sandy clay loam, loam, fine sandy loam.	CL, SC	A-6	0	90-100	90-99	85-95	40-60	28-40	11-20
43, 44, 45--------- Konsil	0-9	Fine sandy loam	CL, ML, SC, SM	A-4	0	90-100	90-100	85-95	36-55	20-28	3-10
	9-65	Sandy clay loam, loam, fine sandy loam.	CL, SC	A-6	0	90-100	90-99	85-95	40-60	28-40	11-20
46, 47---------- Lewisville	0-19	Silty clay------	CL, CH	A-7	0	100	99-100	82-99	80-95	41-59	20-36
	19-38	Silty clay, clay loam, silty clay loam.	CL, CH	A-7	0	99-100	98-100	73-99	72-95	48-60	25-36
	38-75	Silty clay, clay loam, silty clay loam.	CL, CH, SC	A-6, A-7	0	83-100	65-99	56-98	41-95	30-55	12-34
48---------- Lindy	0-8	Loam----------	CL, CL-ML	A-4, A-6	0-15	75-100	70-100	70-100	60-85	20-40	5-20
	8-31	Clay loam, clay	CL, CH	A-6, A-7	0-5	80-100	75-100	75-100	65-90	35-60	15-35
	31-34	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
49*: Lindy----------	0-8	Loam----------	CL, CL-ML	A-4, A-6	0-15	75-100	70-100	70-100	60-85	20-40	5-20
	8-31	Clay loam, clay	CL, CH	A-6, A-7	0-5	80-100	75-100	75-100	65-90	35-60	15-35
	31-34	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Urban land.											
50, 51---------- Mabank	0-8	Loam----------	CL, ML, SM, SC	A-4	0	95-100	95-100	80-98	40-70	<30	NP-10
	8-92	Clay, clay loam	CH, CL	A-7, A-6	0	95-100	95-100	95-100	60-85	35-65	20-40
52, 53---------- Normangee	0-7	Clay loam-------	CL	A-6, A-7	0	98-100	96-100	90-100	55-85	30-48	11-25
	7-55	Clay----------	CL, CH	A-7	0	98-100	98-100	90-100	70-96	44-80	22-58
	55-65	Stratified shaly clay.	CL, CH	A-7	0	95-100	90-100	90-100	70-90	41-60	20-35
54*: Normangee---------	0-7	Clay loam-------	CL	A-6, A-7	0	98-100	96-100	90-100	55-85	30-48	11-25
	7-55	Clay----------	CL, CH	A-7	0	98-100	98-100	90-100	70-96	44-80	22-58
	55-65	Stratified shaly clay.	CL, CH	A-7	0	95-100	90-100	90-100	70-90	41-60	20-35
Urban land.											
55*---------- Normangee	0-7	Clay loam-------	CL	A-6, A-7	0	98-100	96-100	90-100	55-85	30-48	11-25
	7-55	Clay----------	CL, CH	A-7	0	98-100	98-100	90-100	70-96	44-80	22-58
	55-65	Stratified shaly clay.	CL, CH	A-7	0	95-100	90-100	90-100	70-90	41-60	20-35
56---------- Okay	0-12	Fine sandy loam	SM, SC, ML, CL	A-4	0	100	98-100	94-100	36-85	<31	NP-10
	12-44	Clay loam, loam, sandy clay loam.	SC, CL, ML, SM	A-4, A-6	0	100	100	90-100	36-90	25-40	7-18
	44-65	Loam, sandy clay loam, fine sandy loam.	SM, SC, ML, CL	A-4, A-6	0	100	98-100	90-100	36-90	<34	NP-13

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
57---------- Oklared	0-7	Very fine sandy loam.	SM, SC, ML, CL	A-4	0	100	98-100	94-100	36-60	<30	NP-10
	7-30	Fine sandy loam, very fine sandy loam, loam.	SM, SC, ML, CL	A-4	0	100	98-100	94-100	36-60	<30	NP-10
	30-74	Fine sandy loam, very fine sandy loam, loamy fine sand.	SM, SC, ML, CL	A-2, A-4	0	100	98-100	90-100	15-60	<30	NP-10
58*:											
Oklared-----------	0-7	Very fine sandy loam.	SM, SC, ML, CL	A-4	0	100	98-100	94-100	36-60	<30	NP-10
	7-50	Fine sandy loam, very fine sandy loam, loam.	SM, SC, ML, CL	A-4	0	100	98-100	94-100	36-60	<30	NP-10
	50-74	Fine sandy loam, very fine sandy loam, loamy fine sand.	SM, SC, ML, CL	A-2, A-4	0	100	98-100	90-100	15-60	<30	NP-10
Kiomatia----------	0-7	Loamy fine sand	SM, SM-SC	A-4, A-2-4	0	100	95-100	80-100	30-45	<26	NP-7
	7-80	Stratified fine sand to loam.	SM, SM-SC	A-2-4	0	100	95-100	80-90	13-35	<22	NP-5
59*. Pits											
60---------- Purves	0-8	Clay loam-------	CH	A-7-6	0-5	90-100	80-100	80-95	70-95	51-65	30-40
	8-14	Gravelly clay, very gravelly clay, gravelly clay loam.	CH, SC	A-7-6	0-35	60-100	60-100	55-95	45-90	51-65	30-40
	14-16	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
61---------- Redlake	0-60	Clay------------	CL, CH, ML, MH	A-7	0	100	100	98-100	90-99	41-70	18-38
62, 63---------- Sanger	0-23	Clay------------	CH	A-7-6	0	95-100	95-100	90-100	80-95	51-70	28-42
	23-49	Clay, silty clay	CH, CL	A-7-6, A-6	0	95-100	95-100	90-100	85-100	40-60	20-36
	49-65	Clay, silty clay	CH, CL	A-7-6, A-6	0	95-100	95-100	90-100	85-100	40-55	20-35
64---------- Sanger	0-7	Stony clay------	CH	A-7-6	2-20	90-100	90-100	85-100	75-95	51-70	28-42
	7-41	Clay, silty clay	CH, CL	A-7-6, A-6	0	90-100	90-100	75-100	70-99	40-60	20-36
	41-60	Clay, silty clay	CH, CL	A-7-6, A-6	0	90-100	90-100	85-100	80-100	40-55	20-35
65---------- Speck Variant	0-5	Loam------------	CL	A-6	0	80-100	80-100	70-95	51-75	30-38	12-18
	5-15	Clay------------	CL, CH	A-7-6	0	80-100	80-100	75-95	60-95	48-58	25-32
	15-18	Weathered bedrock.	---	---	---	---	---	---	---	---	---
66, 67---------- Stephen	0-13	Silty clay------	CL, CH	A-7-6	0-5	95-100	90-100	85-100	80-90	45-66	22-42
	13-18	Variable--------	---	---	---	---	---	---	---	---	---
	18-23	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
68---------- Trinity	0-65	Clay------------	CH	A-7	0	100	98-100	85-100	80-99	55-90	30-60
69*. Urban land											

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
70, 71, 72, 73----- Vertel	0-5	Clay----------	CH	A-7-6	0	95-100	95-100	90-100	90-100	60-85	40-60
	5-33	Clay----------	CH	A-7-6	0	95-100	95-100	90-100	85-100	60-85	40-60
	33-54	Weathered bedrock.	---	---	---	---	---	---	---	---	---
74*: Vertel----------	0-5	Clay----------	CH	A-7-6	0	95-100	95-100	90-100	90-100	60-85	40-60
	5-33	Clay----------	CH	A-7-6	0	95-100	95-100	90-100	85-100	60-85	40-60
	33-54	Weathered bedrock.	---	---	---	---	---	---	---	---	---
Urban land.											
75----------------- Whitesboro	0-27	Loam----------	CL	A-6, A-7-6	0	100	98-100	85-100	60-80	30-43	11-24
	27-72	Loam, clay loam, sandy clay loam.	CL	A-6, A-7-6	0	100	98-100	85-100	60-85	30-45	11-25
76*, 77*: Whitewright-------	0-5	Silty clay loam	CL, CH	A-6, A-7	0	95-100	95-100	85-100	60-98	38-52	19-32
	5-16	Silty clay loam, clay loam, gravelly clay loam.	CL, CH	A-6, A-7	0	85-100	85-100	70-100	60-98	38-52	19-32
	16-34	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Eddy----------	0-5	Gravelly clay loam.	GC	A-2, A-6	0-20	40-50	35-50	30-45	20-40	30-40	11-20
	5-13	Gravelly clay loam, very gravelly loam, very gravelly clay loam.	GC, GP-GC	A-2	0-60	20-50	15-45	10-38	8-35	30-40	11-20
	13-16	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Howe----------	0-7	Silty clay loam	CL, CH	A-7-6, A-6	0	95-100	95-100	85-100	55-90	35-52	15-30
	7-26	Silty clay loam, clay loam, silty clay.	CL, CH	A-7-6, A-6	0	95-100	90-100	85-100	65-95	35-52	15-30
	26-32	Weathered bedrock.	---	---	---	---	---	---	---	---	---
78*: Whitewright-------	0-5	Silty clay loam	CL, CH	A-6, A-7	0	95-100	95-100	85-100	60-98	38-52	19-32
	5-16	Silty clay loam, clay loam, gravelly clay loam.	CL, CH	A-6, A-7	0	85-100	85-100	70-100	60-98	38-52	19-32
	16-34	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Gullied land.											
79, 80---------- Wilson	0-8	Silty clay loam	CL	A-6	0	95-100	85-100	80-100	60-96	25-36	10-20
	8-34	Silty clay, clay, clay loam.	CL, CH	A-7-6, A-6	0	90-100	80-100	80-100	65-96	38-55	21-35
	34-65	Silty clay, clay	CL, CH	A-7-6, A-6	0	95-100	90-100	85-100	70-96	38-65	24-48
81*---------- Zilaboy	0-40	Clay----------	CH	A-7	0	100	98-100	85-100	80-95	55-65	30-40
	40-70	Clay, silty clay	CH	A-7	0	100	98-100	85-100	80-95	55-65	30-40

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES

[The symbol < means less than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated]

Soil name and map symbol	Depth	Clay <2mm	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
							K	T		
	In	Pct	In/hr	In/in	pH					Pct
1----------	0-3	20-35	0.6-2.0	0.07-0.18	7.9-8.4	Moderate-----	0.32	1	---	---
Aledo	3-8	20-35	0.6-2.0	0.05-0.12	7.9-8.4	Low----------	0.10			
	8-12	---	---	---	---	----------	---			
2*----------	0-8	20-35	0.6-2.0	0.05-0.12	7.9-8.4	Low----------	0.10	---	---	---
Aledo	8-12	---	---	---	---	----------	---			
3----------	0-32	---	0.6-2.0	0.15-0.18	7.9-8.4	High---------	0.32	5	---	---
Altoga	32-65	---	0.6-2.0	0.15-0.18	7.9-8.4	Moderate-----	0.32			
4----------	0-4	5-15	2.0-6.0	0.11-0.17	5.6-7.3	Low----------	0.32	3	3	---
Aubrey	4-26	40-60	0.06-0.2	0.15-0.20	3.6-6.0	Moderate-----	0.32			
	26-50	---	---	---	---	----------	---			
5*:										
Aubrey----------	0-6	5-15	2.0-6.0	0.09-0.15	5.6-7.3	Low----------	0.32	3	8	---
	6-32	40-60	0.06-0.2	0.15-0.20	3.6-6.0	Moderate-----	0.32			
	32-60	---	---	---	---	----------	---			
Birome----------	0-8	10-20	0.6-2.0	0.08-0.15	5.6-7.3	Low----------	0.32	2	8	---
	8-25	35-55	0.2-0.6	0.15-0.20	4.0-6.0	Moderate-----	0.28			
	25-31	30-50	0.6-2.0	0.12-0.18	4.0-6.0	Moderate-----	0.28			
	31-35	---	---	---	---	----------	---			
6*:										
Aubrey----------	0-6	5-15	2.0-6.0	0.09-0.15	5.6-7.3	Low----------	0.32	3	8	---
	6-32	40-60	0.06-0.2	0.15-0.20	3.6-6.0	Moderate-----	0.32			
	32-60	---	---	---	---	----------	---			
Birome----------	0-8	10-20	0.6-2.0	0.08-0.15	5.6-7.3	Low----------	0.32	2	8	---
	8-25	35-55	0.2-0.6	0.15-0.20	4.0-6.0	Moderate-----	0.28			
	25-31	30-50	0.6-2.0	0.12-0.18	4.0-6.0	Moderate-----	0.28			
	31-35	---	---	---	---	----------	---			
Urban land.										
7*----------	0-4	5-15	2.0-6.0	0.11-0.17	5.6-7.3	Low----------	0.32	3	3	---
Aubrey	4-26	40-60	0.06-0.2	0.15-0.20	3.6-6.0	Moderate-----	0.32			
	26-50	---	---	---	---	----------	---			
8, 9----------	0-11	35-55	0.2-0.6	0.15-0.20	7.9-8.4	High---------	0.32	2	---	1-4
Austin	11-30	35-55	0.2-0.6	0.15-0.20	7.9-8.4	Moderate-----	0.32			
	30-36	---	---	---	---	----------	---			
10*:										
Austin----------	0-11	35-55	0.2-0.6	0.15-0.20	7.9-8.4	High---------	0.32	2	---	1-4
	11-30	35-55	0.2-0.6	0.15-0.20	7.9-8.4	Moderate-----	0.32			
	30-36	---	---	---	---	----------	---			
Urban land.										
11, 12----------	0-6	10-20	2.0-6.0	0.11-0.17	5.6-7.3	Low----------	0.37	5	3	5-1
Bastrop	6-62	20-35	0.6-2.0	0.15-0.19	5.6-8.4	Low----------	0.32			
13, 14----------	0-10	25-40	0.6-2.0	0.11-0.20	7.9-8.4	Moderate-----	0.32	2	---	1-3
Bolar	10-37	25-40	0.6-2.0	0.11-0.20	7.9-8.4	Moderate-----	0.17			
	37-40	---	---	---	---	----------	---			
15*:										
Bolar----------	0-9	25-40	0.6-2.0	0.10-0.18	7.9-8.4	Moderate-----	0.32	2	---	---
	9-26	25-40	0.6-2.0	0.11-0.20	7.9-8.4	Moderate-----	0.17			
	26-28	---	---	---	---	----------	---			

See footnote at end of table.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES--Continued

Soil name and map symbol	Depth	Clay <2mm	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
							K	T		
	In	Pct	In/hr	In/in	pH					Pct
15*:										
Aledo	0-8	20-35	0.6-2.0	0.05-0.12	7.9-8.4	Low	0.10	---	---	---
	8-10	---	---	---	---	---	---			
16*:										
Bunyan	0-22	8-25	2.0-6.0	0.11-0.15	6.1-7.3	Low	0.43	5	---	<1
	22-48	18-35	0.6-2.0	0.15-0.19	5.6-8.4	Low	0.43			
	48-65	18-35	0.6-2.0	0.18-0.22	6.6-8.4	Low	0.43			
Whitesboro	0-27	22-35	0.6-2.0	0.15-0.20	6.1-7.8	Moderate	0.28	5	---	1-2
	27-72	22-35	0.6-2.0	0.15-0.20	6.1-8.4	Moderate	0.28			
17, 18, 19, 20*--	0-5	8-20	0.6-2.0	0.12-0.17	5.6-7.3	Low	0.32	5	3	<1
Callisburg	5-16	30-50	0.2-0.6	0.14-0.20	5.1-7.3	Moderate	0.32			
	16-62	35-50	0.2-0.6	0.15-0.20	5.1-7.8	Moderate	0.32			
21, 22, 23-------	0-4	5-20	0.6-2.0	0.11-0.20	5.6-7.3	Low	0.43	5	---	<2
Crockett	4-65	35-55	<0.06	0.14-0.18	5.6-8.4	High	0.32			
24*:										
Crockett--------	0-4	5-20	0.6-2.0	0.11-0.20	5.6-7.3	Low	0.43	5	---	<2
	4-65	35-55	<0.06	0.14-0.18	5.6-8.4	High	0.32			
Urban land.										
25, 26----------	0-3	5-15	0.6-2.0	0.10-0.14	5.6-7.8	Low	0.43	3	3	<1
Crosstell	3-43	40-60	<0.06	0.14-0.18	4.5-8.4	High	0.37			
	43-60	40-60	<0.06	0.14-0.18	6.6-8.4	High	0.37			
27*:										
Crosstell-------	0-3	5-15	0.6-2.0	0.10-0.14	5.6-7.8	Low	0.43	3	3	<1
	3-43	40-60	<0.06	0.14-0.18	4.5-8.4	High	0.37			
	43-60	40-60	<0.06	0.14-0.18	6.6-8.4	High	0.37			
Urban land.										
28---------------	0-5	20-40	0.2-0.6	0.10-0.13	7.9-8.4	Low	0.24	1	---	1-3
Eddy	5-13	20-40	0.2-0.6	0.03-0.07	7.9-8.4	Low	0.24			
	13-16	---	---	---	---	---	---			
29, 30*----------	0-23	30-40	0.2-0.6	0.14-0.18	7.4-8.4	High	0.32	5	---	1-3
Elbon	23-65	35-60	0.2-0.6	0.12-0.18	7.4-8.4	High	0.32			
31*:										
Fairlie---------	0-5	32-50	<0.06	0.14-0.20	7.4-8.4	Very high	0.32	5	---	1-4
	5-46	35-60	<0.06	0.14-0.20	7.4-8.4	Very high	0.32			
	46-55	---	---	---	---	---	---			
Urban land.										
32*, 33*:										
Fairlie---------	0-5	32-50	<0.06	0.14-0.20	7.4-8.4	Very high	0.32	5	---	1-4
	5-46	35-60	<0.06	0.14-0.20	7.4-8.4	Very high	0.32			
	46-55	---	---	---	---	---	---			
Houston Black---	0-17	40-60	<0.06	0.15-0.20	7.4-8.4	Very high	0.32	5	---	1-4
	17-65	40-60	<0.06	0.15-0.20	7.4-8.4	Very high	0.32			
34, 35----------	0-10	5-12	6.0-20	0.07-0.11	6.1-7.8	Low	0.20	5	2	<1
Gasil	10-66	15-35	0.6-2.0	0.12-0.19	5.1-6.5	Moderate	0.32			
36*:										
Gasil----------	0-10	5-12	6.0-20	0.07-0.11	6.1-7.8	Low	0.20	5	2	<1
	10-66	15-35	0.6-2.0	0.12-0.19	5.1-6.5	Moderate	0.32			
Urban land.										
37*---------------	0-10	5-12	6.0-20	0.07-0.11	6.1-7.8	Low	0.20	5	2	<1
Gasil	10-66	15-35	0.6-2.0	0.12-0.19	5.1-6.5	Moderate	0.32			

See footnote at end of table.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES--Continued

Soil name and map symbol	Depth	Clay <2mm	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
							K	T		
	In	Pct	In/hr	In/in	pH					Pct
38----------	0-28	3-12	2.0-6.0	0.05-0.09	5.6-7.3	Very low-----	0.17	5	2	<.5
Heaton	28-53	20-35	0.6-2.0	0.14-0.16	5.6-7.3	Low----------	0.24			
	53-65	10-30	0.6-2.0	0.10-0.14	5.6-7.3	Low----------	0.24			
39, 40----------	0-14	40-60	<0.06	0.15-0.20	7.9-8.4	Very high----	0.32	5	---	1-3
Heiden	14-60	40-60	<0.06	0.12-0.20	7.9-8.4	Very high----	0.32			
41----------	0-7	30-45	0.6-2.0	0.15-0.18	7.9-8.4	Moderate-----	0.32	3	---	<1
Howe	7-26	30-45	0.6-2.0	0.10-0.18	7.9-8.4	Moderate-----	0.32			
	26-32	---	---	---	---	----------	---			
42----------	0-11	5-12	6.0-20	0.07-0.11	6.1-7.8	Low----------	0.20	5	2	<1
Konsil	11-65	18-33	0.6-2.0	0.12-0.19	5.1-6.5	Moderate-----	0.32			
43, 44, 45-------	0-9	8-20	2.0-6.0	0.11-0.15	6.1-7.8	Low----------	0.24	5	3	<1
Konsil	9-65	18-33	0.6-2.0	0.12-0.19	5.1-6.5	Moderate-----	0.32			
46, 47----------	0-19	28-45	0.6-2.0	0.16-0.20	7.9-8.4	High---------	0.32	5	---	1-3
Lewisville	19-38	30-45	0.6-2.0	0.14-0.18	7.9-8.4	High---------	0.37			
	38-75	30-50	0.6-2.0	0.14-0.18	7.9-8.4	High---------	0.37			
48----------	0-8	20-35	0.6-2.0	0.12-0.20	6.1-7.8	Low----------	0.32	2	---	.5-2
Lindy	8-31	35-60	0.06-0.2	0.10-0.20	6.1-7.8	Moderate-----	0.32			
	31-34	---	---	---	---	----------	---			
49*:										
Lindy----------	0-8	20-35	0.6-2.0	0.12-0.20	6.1-7.8	Low----------	0.32	2	---	.5-2
	8-31	35-60	0.06-0.2	0.10-0.20	6.1-7.8	Moderate-----	0.32			
	31-34	---	---	---	---	----------	---			
Urban land.										
50, 51----------	0-8	10-25	0.6-2.0	0.11-0.15	5.6-7.3	Low----------	0.43	5	---	1-2
Mabank	8-80	35-50	<0.06	0.12-0.18	5.6-8.4	High---------	0.32			
52, 53----------	0-7	25-35	0.06-0.2	0.15-0.20	5.6-7.3	Moderate-----	0.32	4	---	.5-2
Normangee	7-55	40-55	<0.06	0.12-0.18	5.6-8.4	High---------	0.32			
	55-65	40-55	<0.06	0.12-0.18	6.1-8.4	High---------	0.32			
54*:										
Normangee-------	0-7	25-35	0.06-0.2	0.15-0.20	5.6-7.3	Moderate-----	0.32	4	---	.5-2
	7-55	40-55	<0.06	0.12-0.18	5.6-8.4	High---------	0.32			
	55-65	40-55	<0.06	0.12-0.18	6.1-8.4	High---------	0.32			
Urban land.										
55*----------	0-7	25-35	0.06-0.2	0.15-0.20	5.6-7.3	Moderate-----	0.32	4	---	.5-2
Normangee	7-55	40-55	<0.06	0.12-0.18	5.6-8.4	High---------	0.32			
	55-65	40-55	<0.06	0.12-0.18	6.1-8.4	High---------	0.32			
56----------	0-12	---	2.0-6.0	0.11-0.16	5.6-6.5	Low----------	0.37	5	---	---
Okay	12-44	---	0.6-2.0	0.12-0.18	5.1-6.5	Low----------	0.37			
	44-65	---	0.6-6.0	0.11-0.17	5.1-7.3	Low----------	0.37			
57----------	0-7	---	2.0-6.0	0.12-0.16	7.4-8.4	Low----------	0.32	5	---	---
Oklared	7-30	---	2.0-6.0	0.12-0.16	7.4-8.4	Low----------	0.32			
	30-74	---	2.0-20	0.10-0.16	7.4-8.4	Low----------	0.32			
58*:										
Oklared----------	0-7	---	2.0-6.0	0.12-0.16	7.4-8.4	Low----------	0.32	5	---	---
	7-50	---	2.0-6.0	0.12-0.16	7.4-8.4	Low----------	0.32			
	50-74	---	2.0-20	0.10-0.16	7.4-8.4	Low----------	0.32			
Kiomatia---------	0-7	5-15	0.6-2.0	0.10-0.15	6.1-8.4	Low----------	0.17	5	---	<1
	7-80	2-15	6.0-20	0.05-0.10	6.1-8.4	Low----------	0.17			
59*.										
Pits										

See footnote at end of table.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES--Continued

Soil name and map symbol	Depth	Clay <2mm	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
							K	T		
	In	Pct	In/hr	In/in	pH					Pct
60----------	0-8	35-55	0.2-0.6	0.12-0.18	7.9-8.4	High----------	0.32	1	---	1-3
Purves	8-14	35-55	0.2-0.6	0.08-0.18	7.9-8.4	High----------	0.32			
	14-16	---	---	---	---	----------	---			
61----------	0-60	---	<0.06	0.12-0.18	7.4-8.4	High----------	0.37	5	---	---
Redlake										
62, 63----------	0-23	40-60	<0.06	0.12-0.18	7.4-8.4	High----------	0.32	5	---	1-3
Sanger	23-49	40-60	<0.06	0.12-0.18	7.9-8.4	High----------	0.32			
	49-65	40-60	<0.06	0.12-0.18	7.9-8.4	High----------	0.32			
64----------	0-7	40-60	<0.06	0.10-0.18	7.4-8.4	High----------	0.28	5	---	---
Sanger	7-41	40-60	<0.06	0.12-0.18	7.9-8.4	High----------	0.32			
	41-60	40-60	<0.06	0.12-0.18	7.9-8.4	High----------	0.32			
65----------	0-5	20-27	0.2-0.6	0.15-0.20	7.4-8.4	Moderate------	0.32	1	---	1-2
Speck Variant	5-15	40-50	0.06-0.2	0.10-0.20	7.4-8.4	Moderate------	0.32			
	15-18	---	---	---	---	----------	---			
66, 67----------	0-13	35-50	0.2-0.6	0.10-0.15	7.9-8.4	Moderate------	0.32	1	---	1-3
Stephen	13-18	---	---	---	---	----------	---			
	18-23	---	---	---	---	----------	---			
68----------	0-65	60-80	<0.06	0.15-0.20	7.4-8.4	Very high-----	0.32	5	---	1-4
Trinity										
69*.										
Urban land										
70, 71, 72, 73---	0-5	60-80	<0.06	0.09-0.18	6.6-8.4	Very high-----	0.37	3	---	.5-1
Vertel	5-33	60-80	<0.06	0.10-0.18	6.6-8.4	Very high-----	0.37			
	33-54	---	---	---	---	----------	---		---	---
74*:										
Vertel----------	0-5	60-80	<0.06	0.09-0.18	6.6-8.4	Very high-----	0.37	3	---	.5-1
	5-33	60-80	<0.06	0.10-0.18	6.6-8.4	Very high-----	0.37			
	33-54	---	---	---	---	----------	---		---	---
Urban land.										
75----------	0-27	22-35	0.6-2.0	0.15-0.20	6.1-7.8	Moderate------	0.28	5	---	1-2
Whitesboro	27-72	22-35	0.6-2.0	0.15-0.20	6.1-8.4	Moderate------	0.28			
76*, 77*:										
Whitewright-----	0-5	---	0.6-2.0	0.15-0.20	7.9-8.4	Moderate------	0.32	2	---	1-3
	5-16	---	0.6-2.0	0.13-0.20	7.9-8.4	Moderate------	0.32			
	16-34	---	---	---	---	----------	---			
Eddy----------	0-5	20-40	0.2-0.6	0.10-0.13	7.9-8.4	Low-----------	0.24	1	---	1-3
	5-13	20-40	0.2-0.6	0.03-0.07	7.9-8.4	Low-----------	0.24			
	13-16	---	---	---	---	----------	---			
Howe----------	0-7	30-45	0.6-2.0	0.15-0.18	7.9-8.4	Moderate------	0.32	3	---	<1
	7-26	30-45	0.6-2.0	0.10-0.18	7.9-8.4	Moderate------	0.32			
	26-32	---	---	---	---	----------	---			
78*:										
Whitewright-----	0-5	---	0.6-2.0	0.15-0.20	7.9-8.4	Moderate------	0.32	2	---	1-3
	5-16	---	0.6-2.0	0.13-0.20	7.9-8.4	Moderate------	0.32			
	16-34	---	---	---	---	----------	---			
Gullied land.										
79, 80----------	0-8	27-40	0.2-0.6	0.15-0.20	5.6-7.3	Low-----------	0.43	5	---	5-2
Wilson	8-34	35-50	<0.06	0.14-0.20	5.6-8.4	High----------	0.37			
	34-65	35-50	<0.06	0.12-0.15	6.6-8.4	High----------	0.37			
81*----------	0-40	40-55	<0.06	0.15-0.20	6.1-7.8	High----------	0.32	5	---	1-3
Zilaboy	40-70	40-55	<0.06	0.15-0.20	6.6-8.4	High----------	0.32			

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 17.--SOIL AND WATER FEATURES

[The definition of "water table" in the Glossary explains terms such as "apparent," and "perched." The symbol > means more than. Absence of an entry indicates that the feature is not a concern]

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness	Uncoated steel	Concrete
					Ft			In			
1, 2*---------- Aledo	C	None--------	---	---	>6.0	---	---	8-20	Hard	Moderate	Low.
3---------- Altoga	C	None--------	---	---	>6.0	---	---	>60	---	High-----	Low.
4---------- Aubrey	C	None--------	---	---	>6.0	---	---	20-40	Rippable	High-----	High.
5*: Aubrey----------	C	None--------	---	---	>6.0	---	---	20-40	Rippable	High-----	High.
Birome----------	C	None--------	---	---	>6.0	---	---	20-40	Rippable	High-----	Moderate.
6*: Aubrey----------	C	None--------	---	---	>6.0	---	---	20-40	Rippable	High-----	High.
Birome----------	C	None--------	---	---	>6.0	---	---	20-40	Rippable	High-----	Moderate.
Urban land.											
7*---------- Aubrey	C	None--------	---	---	>6.0	---	---	20-40	Rippable	High-----	High.
8, 9---------- Austin	C	None--------	---	---	>6.0	---	---	20-40	Rippable	High-----	Low.
10*: Austin----------	C	None--------	---	---	>6.0	---	---	20-40	Rippable	High-----	Low.
Urban land.											
11, 12---------- Bastrop	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Low.
13, 14---------- Bolar	C	None--------	---	---	>6.0	---	---	20-40	Rippable	High-----	Low.
15*: Bolar----------	C	None--------	---	---	>6.0	---	---	20-40	Rippable	High-----	Low.
Aledo----------	C	None--------	---	---	>6.0	---	---	8-20	Hard	Moderate	Low.
16*: Bunyan----------	B	Frequent----	Brief-----	Oct-May	>6.0	---	---	>60	---	Moderate	Low.
Whitesboro-------	C	Frequent----	Brief-----	Sep-May	2.0-4.0	Apparent	Oct-May	>60	---	High-----	Low.
17, 18, 19, 20*--- Callisburg	C	None--------	---	---	>6.0	---	---	>60	---	Moderate	Moderate.
21, 22, 23-------- Crockett	D	None--------	---	---	>6.0	---	---	>60	---	High-----	Low.
24*: Crockett---------	D	None--------	---	---	>6.0	---	---	>60	---	High-----	Low.
Urban land.											

See footnote at end of table.

TABLE 17.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness	Uncoated steel	Concrete
					Ft			In			
25, 26---------- Crosstell	D	None---------	---	---	>6.0	---	---	>60	---	High------	Moderate.
27*: Crosstell--------	D	None---------	---	---	>6.0	---	---	>60	---	High------	Moderate.
Urban land.											
28---------- Eddy	C	None---------	---	---	>6.0	---	---	3-15	Rippable	High------	Low.
29---------- Elbon	B	Occasional	Brief-----	Nov-May	2.5-3.5	Apparent	Dec-Apr	>60	---	High------	Low.
30*---------- Elbon	B	Frequent----	Brief-----	Nov-May	2.5-3.5	Apparent	Dec-Apr	>60	---	High------	Low.
31*: Fairlie----------	D	None---------	---	---	>6.0	---	---	40-60	Rippable	High------	Low.
Urban land.											
32*, 33*: Fairlie----------	D	None---------	---	---	>6.0	---	---	40-60	Rippable	High------	Low.
Houston Black----	D	None---------	---	---	>6.0	---	---	>60	---	High------	Low.
34, 35---------- Gasil	B	None---------	---	---	>6.0	---	---	>60	---	Low-------	Moderate.
36*: Gasil----------	B	None---------	---	---	>6.0	---	---	>60	---	Low-------	Moderate.
Urban land.											
37*---------- Gasil	B	None---------	---	---	>6.0	---	---	>60	---	Low-------	Moderate.
38---------- Heaton	A	None---------	---	---	>6.0	---	---	>60	---	Moderate	Low.
39, 40---------- Heiden	D	None---------	---	---	>6.0	---	---	>60	---	High------	Low.
41---------- Howe	C	None---------	---	---	>6.0	---	---	20-40	Rippable	High------	Low.
42, 43, 44, 45---- Konsil	B	None---------	---	---	>6.0	---	---	>60	---	Low-------	Moderate.
46, 47---------- Lewisville	B	None---------	---	---	>6.0	---	---	>60	---	High------	Low.
48---------- Lindy	C	None---------	---	---	>6.0	---	---	24-40	Hard	High------	Low.
49*: Lindy----------	C	None---------	---	---	>6.0	---	---	24-40	Hard	High------	Low.
Urban land.											
50, 51---------- Mabank	D	None---------	---	---	0.6-1.0	Perched	Dec-Mar	>60	---	High------	Moderate.
52, 53---------- Normangee	D	None---------	---	---	>6.0	---	---	>60	---	High------	Low.
54*: Normangee--------	D	None---------	---	---	>6.0	---	---	>60	---	High------	Low.

See footnote at end of table.

TABLE 17.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness	Uncoated steel	Concrete
					Ft			In			
54*: Urban land.											
55*---- Normangee	D	None----	---	---	>6.0	---	---	>60	---	High----	Low.
56---- Okay	B	None----	---	---	>6.0	---	---	>60	---	Moderate	Moderate.
57---- Oklared	B	Rare----	Very brief	Mar-May	3.0-4.0	Apparent	Mar-May	>60	---	Moderate	Low.
58*: Oklared----	B	Occasional	Very brief	Feb-Jun	3.0-4.0	Apparent	Mar-May	>60	---	Moderate	Low.
Kiomatia----	A	Occasional	Brief----	Feb-Jun	3.0-5.0	Apparent	Jan-Jul	>60	---	Low----	Low.
59*. Pits											
60---- Purves	D	None----	---	---	>6.0	---	---	8-20	Hard	High----	Low.
61---- Redlake	D	Occasional	Very brief	Jan-May	>6.0	---	---	>60	---	High----	Low.
62, 63, 64---- Sanger	D	None----	---	---	>6.0	---	---	>60	---	High----	Low.
65---- Speck Variant	D	None----	---	---	>6.0	---	---	14-20	Rippable	High----	Low.
66, 67---- Stephen	C	None----	---	---	>6.0	---	---	7-20	Rippable	High----	Low.
68---- Trinity	D	Occasional	Brief----	Feb-May	0-3.0	Apparent	Nov-Feb	>60	---	High----	Low.
69*. Urban land											
70, 71, 72, 73---- Vertel	D	None----	---	---	>6.0	---	---	24-40	Rippable	High----	Low.
74*: Vertel----	D	None----	---	---	>6.0	---	---	24-40	Rippable	High----	Low.
Urban land.											
75---- Whitesboro	C	Occasional	Brief----	Sep-May	2.0-4.0	Apparent	Oct-May	>60	---	High----	Low.
76*, 77*: Whitewright----	C	None----	---	---	>6.0	---	---	10-20	Rippable	High----	Low.
Eddy----	C	None----	---	---	>6.0	---	---	3-15	Rippable	High----	Low.
Howe----	C	None----	---	---	>6.0	---	---	20-40	Rippable	High----	Low.
78*: Whitewright----	C	None----	---	---	>6.0	---	---	10-20	Rippable	High----	Low.
Gullied land.											
79, 80---- Wilson	D	None----	---	---	0-1.0	Perched	Nov-Mar	>60	---	High----	High.

See footnote at end of table.

TABLE 17.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness	Uncoated steel	Concrete
					Ft			In			
81*---------- Zilaboy	D	Frequent----	Brief-----	Sep-May	0-3.0	Apparent	Oct-May	>60	---	High-----	Low.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 18.--CLASSIFICATION OF THE SOILS

[An asterisk in the first column indicates that the soil is a taxadjunct to the series. See text for a description of those characteristics of the soil that are outside the range of the series]

Soil name	Family or higher taxonomic class
Aledo	Loamy-skeletal, carbonatic, thermic Lithic Haplustolls
Altoga	Fine-silty, carbonatic, thermic Typic Ustochrepts
Aubrey	Clayey, mixed, thermic Typic Haplustults
Austin	Fine-silty, carbonatic, thermic Entic Haplustolls
Bastrop	Fine-loamy, mixed, thermic Udic Paleustalfs
Birome	Fine, mixed, thermic Ultic Paleustalfs
Bolar	Fine-loamy, carbonatic, thermic Typic Calciustolls
Bunyan	Fine-loamy, mixed, nonacid, thermic Typic Ustifluvents
Callisburg	Fine, mixed, thermic Udic Paleustalfs
Crockett	Fine, montmorillonitic, thermic Udertic Paleustalfs
Crosstell	Fine, montmorillonitic, thermic Udertic Paleustalfs
Eddy	Loamy-skeletal, carbonatic, thermic, shallow Typic Ustorthents
Elbon	Fine, mixed, thermic Fluventic Hapludolls
Fairlie	Fine, montmorillonitic, thermic Udic Pellusterts
Gasil	Fine-loamy, siliceous, thermic Ultic Paleustalfs
Heaton	Loamy, siliceous, thermic Arenic Paleustalfs
Heiden	Fine, montmorillonitic, thermic Udic Chromusterts
Houston Black	Fine, montmorillonitic, thermic Udic Pellusterts
Howe	Fine-silty, carbonatic, thermic Typic Ustochrepts
Kiomatia	Sandy, mixed, thermic Typic Udifluvents
Konsil	Fine-loamy, siliceous, thermic Ultic Paleustalfs
Lewisville	Fine-silty, mixed, thermic Typic Calciustolls
Lindy	Fine, mixed, thermic Udic Haplustalfs
Mabank	Fine, montmorillonitic, thermic Vertic Albaqualfs
Normangee	Fine, montmorillonitic, thermic Vertic Haplustalfs
*Okay	Fine-loamy, mixed, thermic Typic Argiudolls
Oklared	Coarse-loamy, mixed (calcareous), thermic Typic Udifluvents
*Purves	Clayey, montmorillonitic, thermic Lithic Calciustolls
Redlake	Fine, mixed, thermic Vertic Eutrochrepts
Sanger	Fine, montmorillonitic, thermic Udic Chromusterts
Speck Variant	Clayey, mixed, thermic Lithic Argiustolls
Stephen	Clayey, mixed, thermic, shallow Entic Haplustolls
Trinity	Very-fine, montmorillonitic, thermic Typic Pelluderts
Vertel	Very-fine, montmorillonitic, thermic Udorthentic Chromusterts
Whitesboro	Fine-loamy, mixed, thermic Cumulic Haplustolls
Whitewright	Loamy, carbonatic, thermic, shallow Typic Ustochrepts
Wilson	Fine, montmorillonitic, thermic Vertic Ochraqualfs
Zilaboy	Fine, montmorillonitic, thermic Aquic Chromuderts

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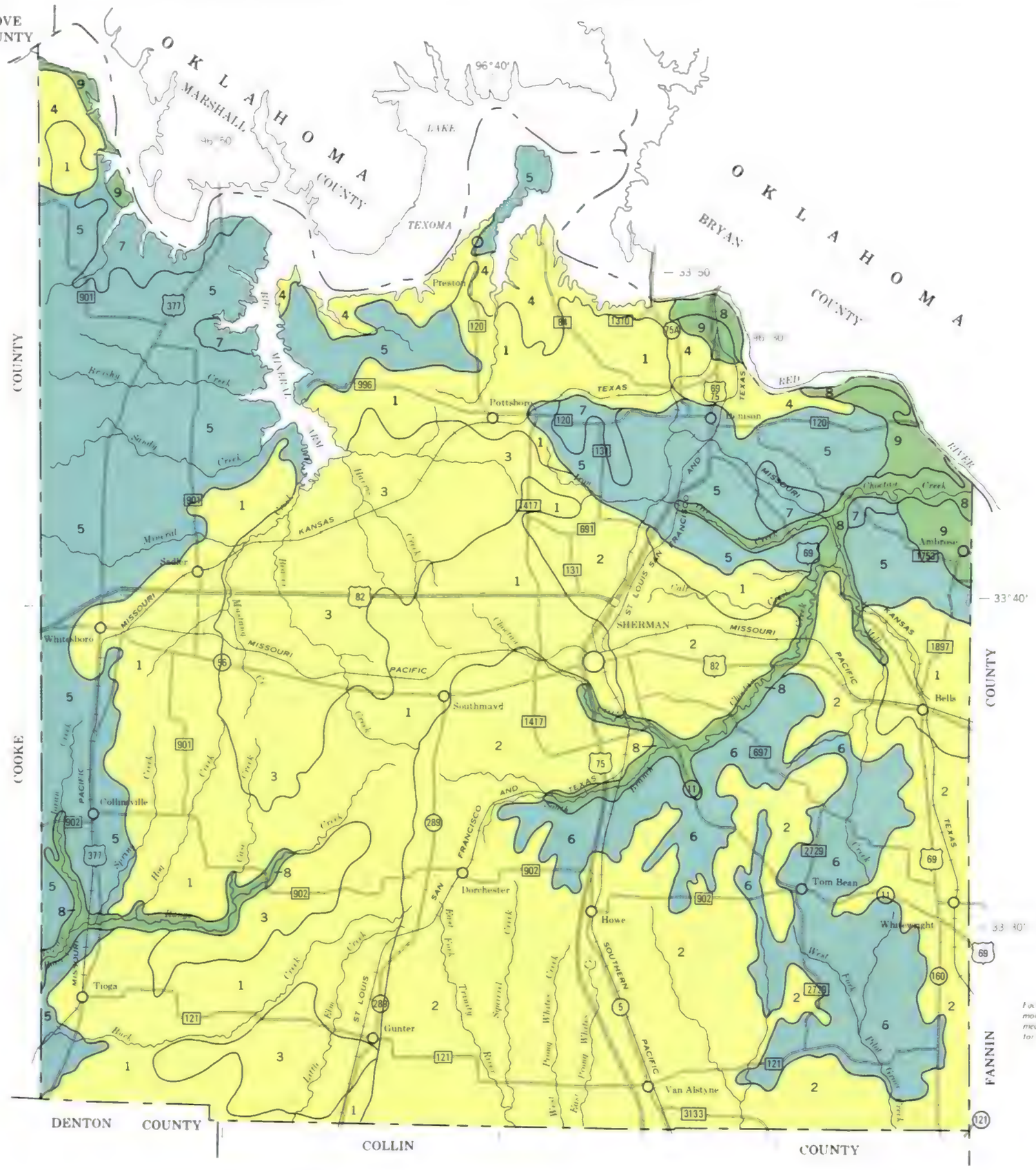


LEGEND

NEARLY LEVEL TO STRONGLY SLOPING, CLAYEY AND LOAMY SOILS; ON UPLANDS

1. Normangee-Crockett-Wilson: Deep, very slowly permeable, loamy soils
2. Fairlie-Austin-Houston Black: Moderately deep and deep, moderately slowly permeable and very slowly permeable, clayey soils
3. Vertel-Heiden: Moderately deep and deep, very slowly permeable, clayey soils
4. Sanger-Bolar: Deep and moderately deep, very slowly permeable and moderately permeable, clayey and loamy soils

GENTLY SLOPING TO STRONGLY SLOPING, LOAMY AND SANDY SOILS; ON UPLANDS

5. Callisburg-Crosstell-Gasil: Deep, moderately permeable to very slowly permeable, loamy and sandy soils
6. Whitewright-Howe-Eddy: Very shallow to moderately deep, moderately permeable and moderately slowly permeable, loamy soils
7. Aubrey: Moderately deep, slowly permeable, loamy soils

NEARLY LEVEL TO GENTLY SLOPING, CLAYEY AND LOAMY SOILS; ON TERRACES AND BOTTOM LANDS

8. Elbon-Trinity-Redlake: Deep, moderately slowly permeable and very slowly permeable, clayey soils
9. Bastrop-Okay-Oklared: Deep, moderately permeable and moderately rapidly permeable, loamy soils

Compiled 1979

Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TEXAS AGRICULTURAL EXPERIMENT STATION

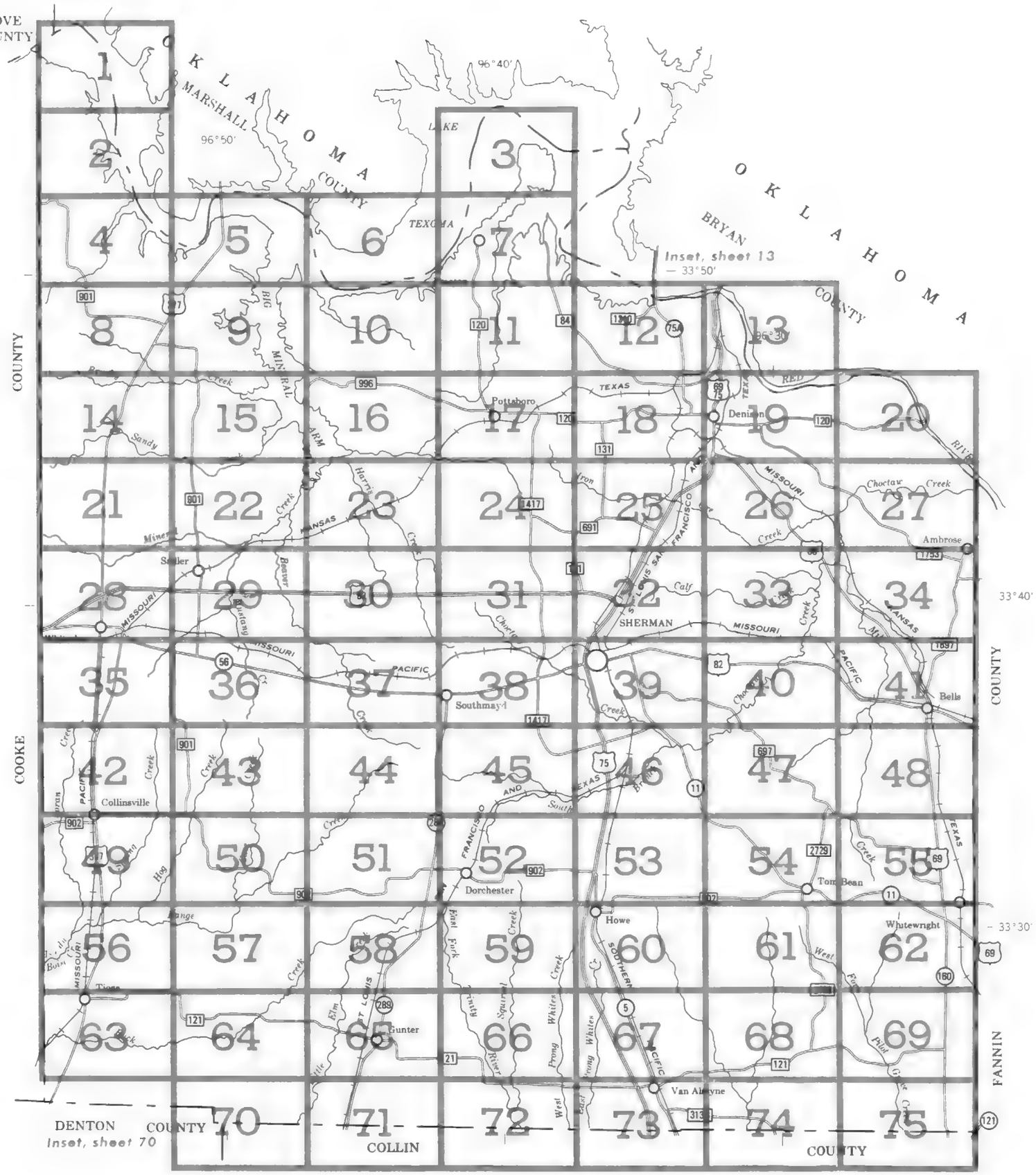
GENERAL SOIL MAP

GRAYSON COUNTY, TEXAS

Scale 1:253,440

1 0 1 2 3 4 Miles

1 0 4 8 Km



Original text from each individual map sheet read:
This map is compiled on 1973 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

N

INDEX TO MAP SHEETS

GRAYSON COUNTY, TEXAS

Scale 1:253,440

1 0 1 2 3 4 Miles

1 0 4 8 Km

SOIL LEGEND

Soil names followed by the superscript 1/ are broadly defined units. These units will be footnoted in the legend of the published soil survey as follows:

SYMBOL	NAME
1	Aledo gravelly clay loam, 3 to 8 percent slopes
2	Aledo soils, hilly 1/
3	Altoga clay loam, 5 to 8 percent slopes
4	Aubrey fine sandy loam, 5 to 8 percent slopes
5	Aubrey-Birome complex, 3 to 12 percent slopes
6	Aubrey-Birome-Urban land complex, 3 to 12 percent slopes
7	Aubrey soils, 3 to 8 percent slopes, severely eroded 1/
8	Austin silty clay, 1 to 3 percent slopes
9	Austin silty clay, 3 to 5 percent slopes
10	Austin-Urban land complex, 1 to 5 percent slopes
11	Bastrop loam, 0 to 1 percent slopes
12	Bastrop loam, 1 to 3 percent slopes
13	Bolar clay loam, 1 to 5 percent slopes
14	Bolar clay loam, 5 to 8 percent slopes
15	Bolar-Aledo complex, 3 to 12 percent slopes
16	Bunyan and Whitesboro soils, frequently flooded 1/
17	Callisburg fine sandy loam, 1 to 3 percent slopes
18	Callisburg fine sandy loam, 2 to 5 percent slopes, eroded
19	Callisburg fine sandy loam, 5 to 8 percent slopes
20	Callisburg soils, 3 to 8 percent slopes, severely eroded 1/
21	Crockett loam, 0 to 1 percent slopes
22	Crockett loam, 1 to 3 percent slopes
23	Crockett loam, 2 to 5 percent slopes, eroded
24	Crockett-Urban land complex, 0 to 3 percent slopes
25	Crosstell fine sandy loam, 1 to 3 percent slopes
26	Crosstell fine sandy loam, 2 to 5 percent slopes, eroded
27	Crosstell-Urban land complex, 1 to 5 percent slopes
28	Eddy gravelly clay loam, 5 to 12 percent slopes
29	Elbon clay, occasionally flooded
30	Elbon soils, frequently flooded 1/
31	Fairlie-Urban land complex, 1 to 5 percent slopes
32	Fairlie and Houston Black clays, 0 to 1 percent slopes 1/
33	Fairlie and Houston Black clays, 1 to 3 percent slopes 1/
34	Gasil loamy fine sand, 1 to 5 percent slopes
35	Gasil loamy fine sand, 5 to 8 percent slopes
36	Gasil-Urban land complex, 1 to 8 percent slopes
37	Gasil soils, 2 to 5 percent slopes, eroded 1/
38	Heeton loamy fine sand, 1 to 5 percent slopes
39	Heiden clay, 1 to 3 percent slopes
40	Heiden clay, 3 to 5 percent slopes
41	Howe silty clay loam, 5 to 8 percent slopes
42	Konsil loamy fine sand, 1 to 5 percent slopes
43	Konsil fine sandy loam, 2 to 5 percent slopes
44	Konsil fine sandy loam, 5 to 8 percent slopes
45	Konsil fine sandy loam, 5 to 8 percent slopes, eroded
46	Lewisville silty clay, 1 to 3 percent slopes
47	Lewisville silty clay, 3 to 5 percent slopes
48	Lindy loam, 1 to 3 percent slopes
49	Lindy-Urban land complex, 1 to 3 percent slopes
50	Mabank loam, 0 to 1 percent slopes
51	Mabank loam, 1 to 3 percent slopes
52	Normangee clay loam, 1 to 4 percent slopes
53	Normangee clay loam, 4 to 8 percent slopes
54	Normangee-Urban land complex, 1 to 4 percent slopes
55	Normangee soils, 3 to 8 percent slopes, severely eroded 1/
56	Okay fine sandy loam, 0 to 1 percent slopes
57	Oklared very fine sandy loam
58	Oklared-Kiomatia complex, occasionally flooded
59	Pits
60	Purves clay loam, 1 to 5 percent slopes
61	Redlake clay, occasionally flooded
62	Sanger clay, 1 to 3 percent slopes
63	Sanger clay, 3 to 5 percent slopes
64	Sanger stony clay, 3 to 8 percent slopes
65	Speck Variant loam, 1 to 3 percent slopes
66	Stephen silty clay, 1 to 3 percent slopes
67	Stephen silty clay, 3 to 5 percent slopes
68	Trinity clay, occasionally flooded
69	Urban land
70	Vertel clay, 1 to 3 percent slopes
71	Vertel clay, 3 to 5 percent slopes
72	Vertel clay, 5 to 12 percent slopes
73	Vertel clay, 5 to 8 percent slopes, severely eroded
74	Vertel-Urban land complex, 8 to 12 percent slopes
75	Whitesboro loam, occasionally flooded
76	Whitewright-Eddy-Howe complex, 1 to 5 percent slopes
77	Whitewright-Eddy-Howe complex, 5 to 12 percent slopes
78	Whitewright-Gullied land complex 1/
79	Wilson silty clay loam, 0 to 1 percent slopes
80	Wilson silty clay loam, 1 to 3 percent slopes
81	Zilaboy soils, frequently flooded 1/

1/ The composition of these units is more variable than that of the others in the survey area but has been controlled well enough to be interpreted for the expected use of the soils.

This Soil Survey includes areas of Bryan County, Oklahoma south of the Red River. Areas of Grayson County, Texas north of the Red River are included with the Bryan County, Oklahoma Soil Survey

CONVENTIONAL AND SPECIAL SYMBOLS LEGEND

CULTURAL FEATURES

BOUNDARIES

- National, state or province
- County or parish
- Minor civil division
- Reservation (national forest or park, state forest or park, and large airport)
- Land grant
- Limit of soil survey (label)
- Field sheet match line & neatline

AD HOC BOUNDARY (label)

- Small airport, airfield, park, oilfield, cemetery, or flood pool (Davis Airstrip; FLOOD POOL LINE)

STATE COORDINATE TICK

LAND DIVISION CORNERS (sections and land grants)

ROADS

- Divided (median shown if scale permits)
- Other roads
- Trail

ROAD EMBLEMS & DESIGNATIONS

- Interstate (78)
- Federal (410)
- State (32)
- County, farm or ranch (378)

RAILROAD

POWER TRANSMISSION LINE (normally not shown)

PIPE LINE (normally not shown)

FENCE (normally not shown)

LEVEES

- Without road
- With road
- With railroad

DAMS

- Large (to scale)
- Medium or small (water)

PITS

- Gravel pit
- Mine or quarry

MISCELLANEOUS CULTURAL FEATURES

- Farmstead, house (omit in urban areas)
- Church
- School
- Indian mound (label) (Indian Mound)
- Located object (label) (Tower)
- Tank (label) (GAS)
- Wells, oil or gas
- Windmill
- Kitchen midden

WATER FEATURES

DRAINAGE

- Perennial, double line
- Perennial, single line
- Intermittent
- Drainage end
- Canals or ditches
  - Double-line (label) (CANAL)
  - Drainage and/or irrigation

LAKES, PONDS AND RESERVOIRS

- Perennial (water, tank)
- Intermittent (dry)

MISCELLANEOUS WATER FEATURES

- Marsh or swamp
- Spring
- Well, artesian
- Well, irrigation
- Wet spot
- Sanitary Landfill (SANITARY LANDFILL)
- Oil Wasteland (OIL WASTELAND)

SPECIAL SYMBOLS FOR SOIL SURVEY

SOIL DELINEATIONS AND SYMBOLS (CeA, FaB2)

ESCARPMENTS

- Bedrock (points down slope)
- Other than bedrock (points down slope)

SHORT STEEP SLOPE

GULLY

DEPRESSION OR SINK

SOIL SAMPLE SITE (normally not shown)

MISCELLANEOUS

- Blowout
- Clay spot
- Gravelly spot
- Gumbo, slick or scabby spot (sodic)
- Dumps and other similar non soil areas
- Prominent hill or peak
- Rock outcrop (includes sandstone and shale)
- Saline spot
- Sandy spot
- Severely eroded spot
- Slide or slip (tips point upslope)
- Stony spot, very stony spot

GRAYSON COUNTY, TEXAS — SHEET NUMBER 1

2 170 000 FEET

8 10 000 FEET

MARSHALL COUNTY OKLAHOMA

LOVE COUNTY OKLAHOMA

COOKE COUNTY

LAKE TEXOMA

FLOOD POOL LINE

(Joins sheet 2)

2 190 000 FEET

N

1 Mile 5000 Feet

Scale 1:20000

(2)

N

(Joins sheet 1)

Brushy Mound

LAKE TEXOMA

LAKE TEXOMA

COUNTY

COOKE COUNTY

OKLAHOMA

Briar Creek

FLOOD POOL LINE

1 Mile 5000 Feet

Scale 1:20000

(Joins sheet 4)

N

2 245 000 FEET

OKLAHOMA COUNTY

MARSHALL COUNTY

OKLAHOMA

MARSHALL

LAKE TEXOMA

LAKE TEXOMA

Preston Point

Preston

PUBLIC ACCESS AREA

LINE

POOL

FLOOD

(Joins sheet 7)

2 265 000 FEET

1 Mile 5000 Feet

Scale 1:20000

4

N

1 Mile
5000 Feet
0
1:20000
Scale 1:20000
1000
2000
3000
4000
5000

(Joins sheet 2)

2 900 000 FEET

COUNTY

COOKE

MARSHALL

COUNTY

OKLAHOMA

LAKE

TEXOMA

FLOOD POOL LINE

Creek

Rock Creek

water

Pilot Point

(Joins sheet 8)

(Joins sheet 5)


MARSHALL COUNTY OKLAHOMA
OKLAHOMA
COUNTY
MARSHALL
LAKE
TEXOMA
LAKE
TEXOMA
Cedar Bayou
FLOOD POOL LINE
(Joins sheet 4)
(Joins sheet 6)
(Joins sheet 9)
N
1 Mile
5000 Feet
Scale 1:20000

GRAYSON COUNTY, TEXAS — SHEET NUMBER 6

6

N

2 240 000 FEET

1 Mile
5 000 Feet
Scale 1:20000

(Joins sheet 5)

MARSHALL

COUNTY

LAKE

TEXOMA

OKLAHOMA

OKLAHOMA

COUNTY

LAKE

TEXOMA

MARSHALL

(Joins sheet 7)

(Joins sheet 10)

(Joins sheet 3)

2 249 000 FEET

LAKE TEXOMA

LAKE TEXOMA

OKLAHOMA COUNTY

MARSHALL

LITTLE MINERAL ARM

BRYAN COUNTY

Rocky Point

Grandpappy Point

FLOOD POOL LINE

(Joins sheet 6)

(Joins sheet 11)

(Joins inset, sheet 13)

7

N

1 Mile

5000 Feet

Scale 1:20000


N
(Joins sheet 4)
(Joins sheet 9)
(Joins sheet 14)
COOKE COUNTY
Scale 1:20000
1 Mile
5000 Feet
Rock Creek
Walnut Creek
North Red Branch
Red Branch
Dry Branch
Brushy Creek
Branch
water


(Joins sheet 5)
(Joins sheet 8)
(Joins sheet 10)
(Joins sheet 15)
LAKE
TEXOMA
BIG
MINERAL
ARM
Walnut Creek
Dry Branch
Gordonville
FLOOD POOL LINE
9
N
1 Mile
5000 Feet
Scale 1:20000

10

N

(Joins sheet 6)

2 240 000 FEET

MARSHALL COUNTY OKLAHOMA

LAKE TEXOMA

LAKE TEXOMA

Lake Texoma

Recreational Area

FLOOD POOL LINE

Mill Creek

Locust

Paradise Cove

Scott Branch

Scott Branch

(Joins sheet 9)

(Joins sheet 11)

(Joins sheet 16)

1 Mile 5,000 Feet

Scale 1:20000

(Joins sheet 7)

(Joins sheet 10)

(Joins sheet 12)

(Joins sheet 17)

11

N

1 Mile

5000 Feet

0

Scale 1:20000

FLOOD POOL LINE

LITTLE MINERAL ARM

Texoma Lake

Recreational Area

Mineral Creek

Little Mineral Creek

GRAYSON COUNTY, TEXAS — SHEET NUMBER 12

12

N

(Joins inset, sheet 13)

2 290 000 FEET

LAKE TEXOMA

BRYAN COUNTY OKLAHOMA

FLOOD POOL LINE

SPILLWAY

water

Randell Lake

Shawnee Creek

1310

75A

84

1 Mile

5000 Feet

Scale 1 : 20000

(Joins sheet 11)

(Joins sheet 13)

(Joins sheet 18)

MISSOURI KANSAS TEXAS

2 295 000 FEET

2 270 000 FEET

RED RIVER

BRYAN COUNTY, OKLAHOMA

LAKE TEXOMA

Warner Junction

Duck Creek

MISSOURI KANSAS TEXAS

ST LOUIS SAN FRANCISCO

FLOOD

(Joins sheet 12)

(Joins sheet 19)

(Joins upper left, sheet 12)

(Joins sheet 7)

13

N

1 Mile 5000 Feet

Scale 1:20000

GRAYSON COUNTY, TEXAS — SHEET NUMBER 14

(14)

N

(Joins sheet 8)

2 190 000 FEET

COUNTY

COOKE

Brushy Creek

Sandusky

Sandy Creek

Sandy Creek

Sandy Creek

Sandy Creek

(Joins sheet 15)

(Joins sheet 21)

1 Mile

5,000 Feet

Scale 1:20000

(Joins sheet 9)

(Joins sheet 14)

(Joins sheet 22)

(Joins sheet 16)

15

N

LAKE TEXOMA

BIG MINERAL ARM

HAGERMAN NATIONAL WILDLIFE REFUGE

LAKE TEXOMA

Brushy Creek

Branch

Copper Creek

Sandy Creek

Sandy Creek

FLOOD POOL LINE

water

1 Mile

5000 Feet

0

Scale 1:20000

0 1000 2000 3000 4000 5000

¼ ½ ¾

16

N

(Joins sheet 10)

2 240 000 FEET

Scale 1:20000

1 Mile 5000 Feet

(Joins sheet 15)

HAGERMAN

LAKE TEXOMA NATIONAL

BIG MINERAL ARM WILDLIFE REFUGE

Scott Branch

FLOOD POOL LINE

water

MISSOURI KANSAS TEXAS

(Joins sheet 17)

(Joins sheet 23)

(Joins sheet 11)

(Joins sheet 16)

(Joins sheet 18)

(Joins sheet 24)

17

N

Pottsboro

Little Mineral Creek

Iron Ore Creek

TEXAS

KANSAS

MISSOURI

996

1417

120

1 Mile

5000 Feet

0

Scale 1:20000

GRAYSON COUNTY, TEXAS — SHEET NUMBER 18

18

N

(Joins sheet 12)

(Joins sheet 17)

(Joins sheet 19)

(Joins sheet 25)

1 Mile

5000 Feet

Scale 1:20000

MISSOURI

KANSAS

TEXAS

Shawnee Creek

Hall Creek

Waterloo Lake

DENISON

PACIFIC

SOUTHERN

(Joins sheet 13)

19

N

BRYAN COUNTY, OKLAHOMA

RED RIVER

BRYAN COUNTY, OKLAHOMA

water

DENISON

Pawpaw Creek

MISSOURI KANSAS TEXAS

SOUTHERN PACIFIC

MISSOURI PACIFIC

KANSAS TEXAS

1 Mile 5000 Feet

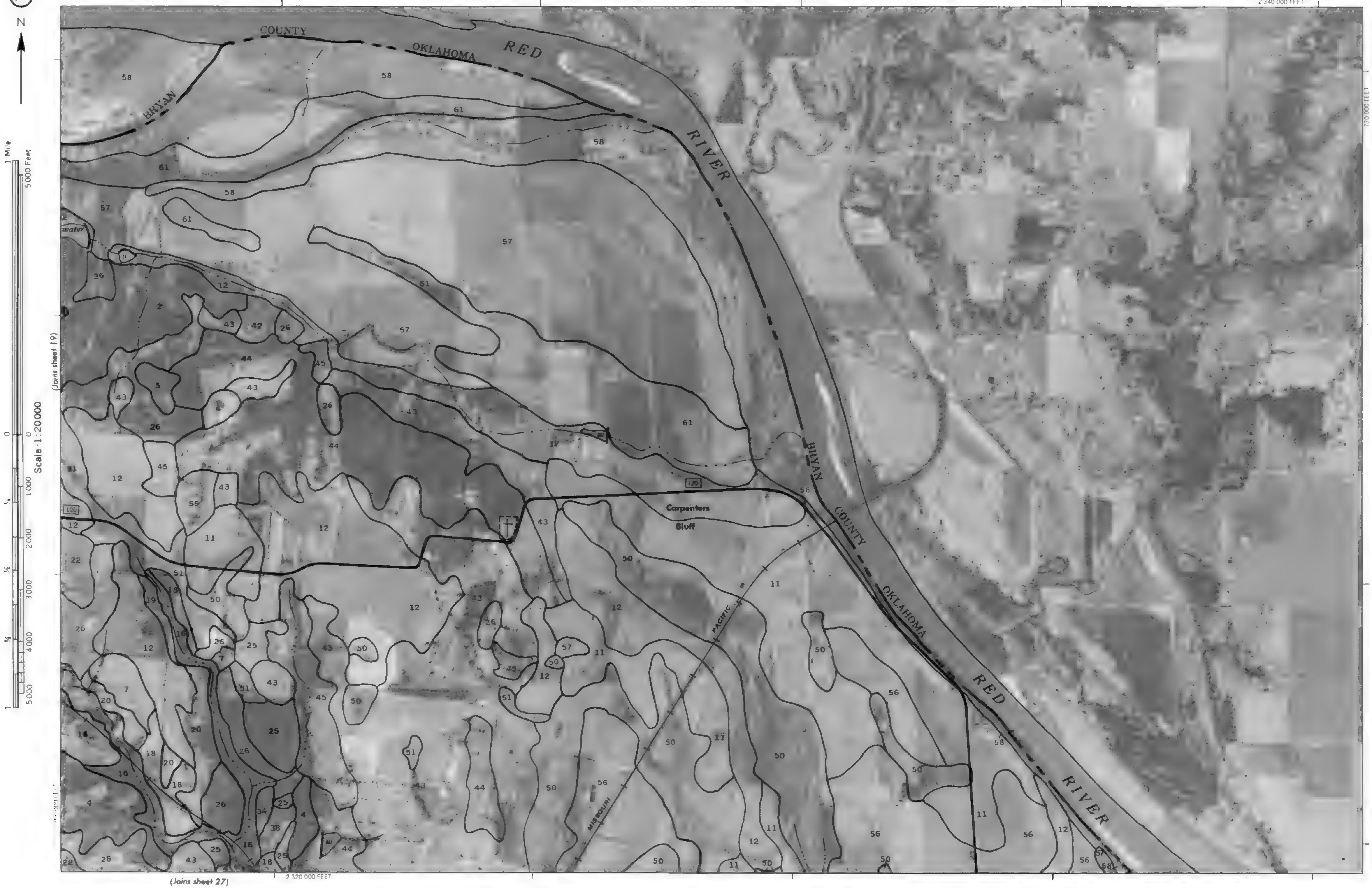
Scale 1:20000

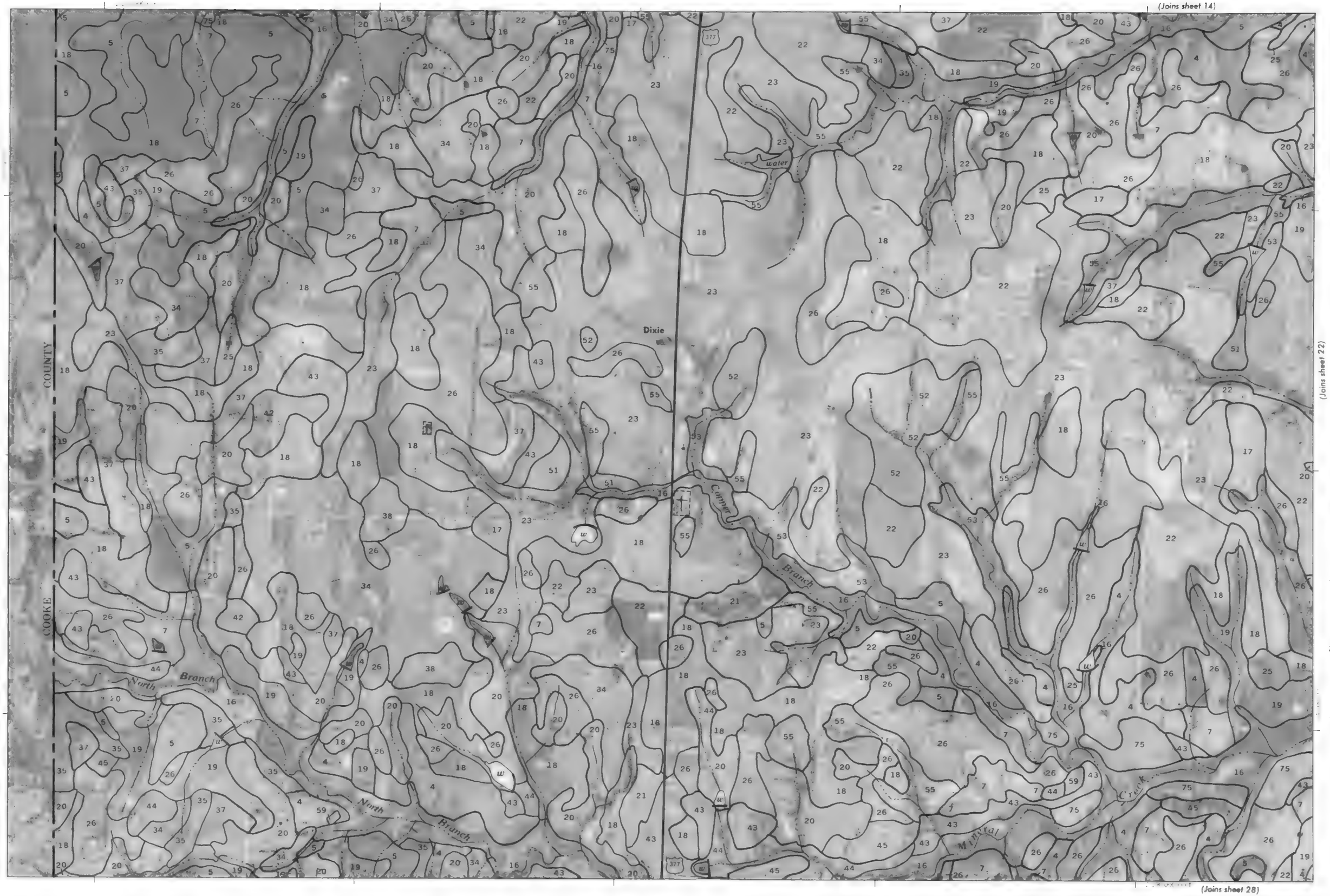
(Joins sheet 20)

(Joins sheet 18)

(Joins sheet 26)

GRAYSON COUNTY, TEXAS — SHEET NUMBER 20




(Joins sheet 14)
COUNTY
COOKE
Dixie
water
Corner
Branch
North
Branch
North
Branch
Mineral
Creek
(Joins sheet 22)
(Joins sheet 28)
377
N
1 Mile
5000 Feet
Scale 1:20000

22

N

(Joins sheet 15)

2 215 000 FEET

HAGERMAN NATIONAL WILDLIFE REFUGE

Sandy Creek

Mineral Creek

Bois d'Arc Creek

Beaver Creek

Mustang Creek

MISSOURI KANSAS TEXAS

FLOOD POOL LINE

water

1 Mile 5000 Feet

0 0

Scale 1:20000

¼ 1000

½ 2000

¾ 3000

1 4000

5000

(Joins sheet 21)

(Joins sheet 23)

2 195 000 FEET

(Joins sheet 29)

GRAYSON COUNTY, TEXAS — SHEET NUMBER 23

2 220 000 FEET

(Joins sheet 16)

23

N

BIG MINERAL ARM LAKE TEXOMA

HAGERMAN NATIONAL WILDLIFE REFUGE

Mineral Creek

Taylor Pond

Martin Branch

Hurtis Creek

Myers Branch

Harris Creek

Marlin Branch

FLOOD POOL

LINE

MISSOURI / KANSAS / TEXAS

TEXAS

KANSAS

MISSOURI

(Joins sheet 22)

(Joins sheet 24)

(Joins sheet 30)

2 240 000 FEET

1 Mile

5 000 Feet

Scale 1:20000

GRAYSON COUNTY, TEXAS — SHEET NUMBER 24

24

N

(Joins sheet 17)

2 265 000 FEET

1 Mile

5 000 Feet

Scale 1:20000

(Joins sheet 23)

740 000 FEET

Grayson County Airfield

Myer Branch

Harris Creek

Iron Ore Creek

Post Oak Creek

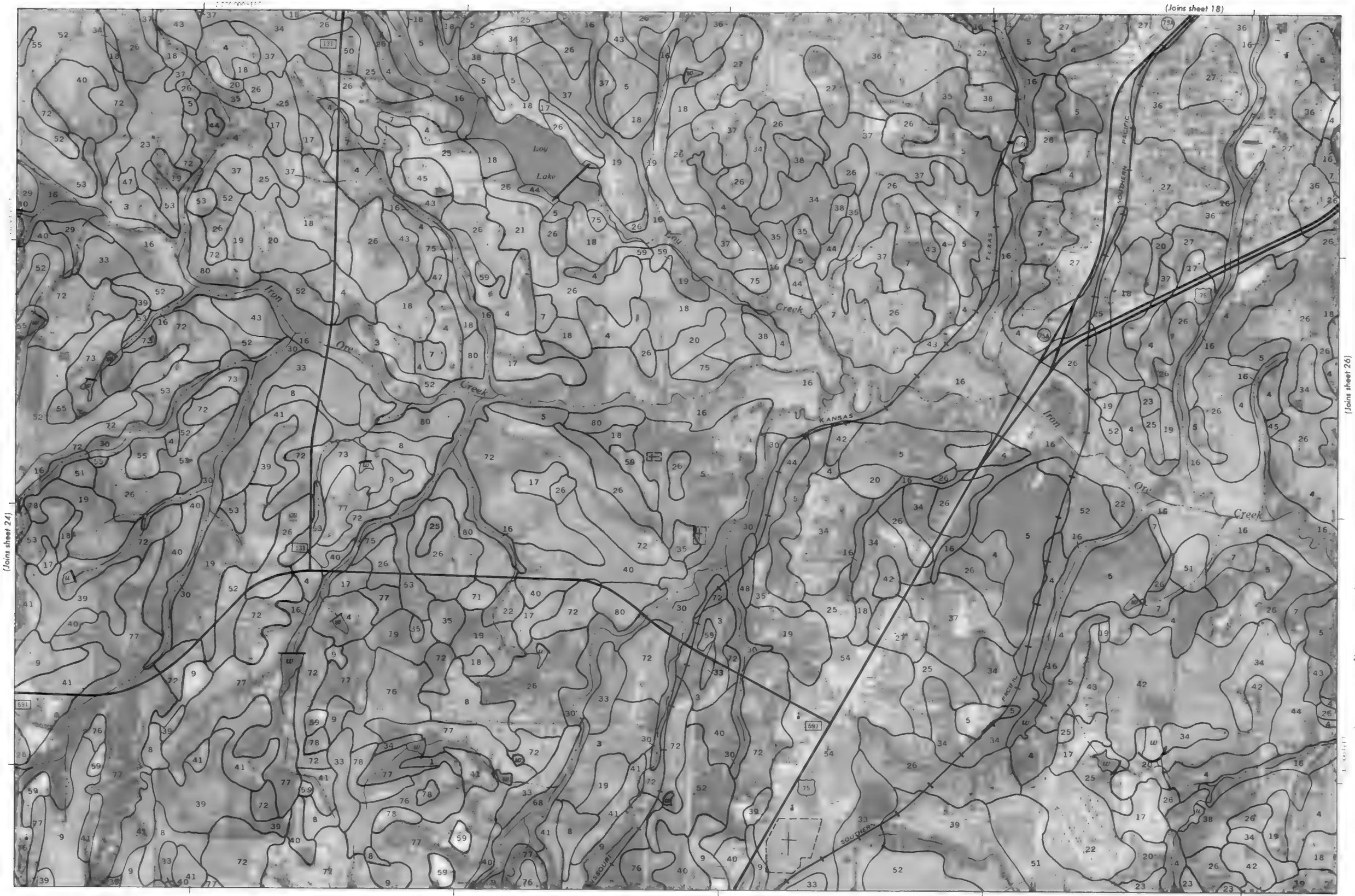
1417

691

(Joins sheet 25)

(Joins sheet 31)

2 245 000 FEET


(Joins sheet 18)
Loy
Lake
Iron
Creek
Ore
Creek
KANSAS
Iron
Ore
Creek
TEXAS
PACIFIC
SOUTHERN
PACIFIC
SOUTHERN
MISSOURI
(Joins sheet 24)
(Joins sheet 32)
(Joins sheet 26)
25
N
1 Mile
5000 Feet
Scale 1:20000

(26)

N

1 Mile
5000 Feet
0
0
Scale 1:20000
¼
½
1
1000
2000
3000
4000
5000

(Joins sheet 19)

2 315 000 FEET

DENISON

MISSOURI

KANSAS

TEXAS

Iron Ore Creek

water

water

Chochaw

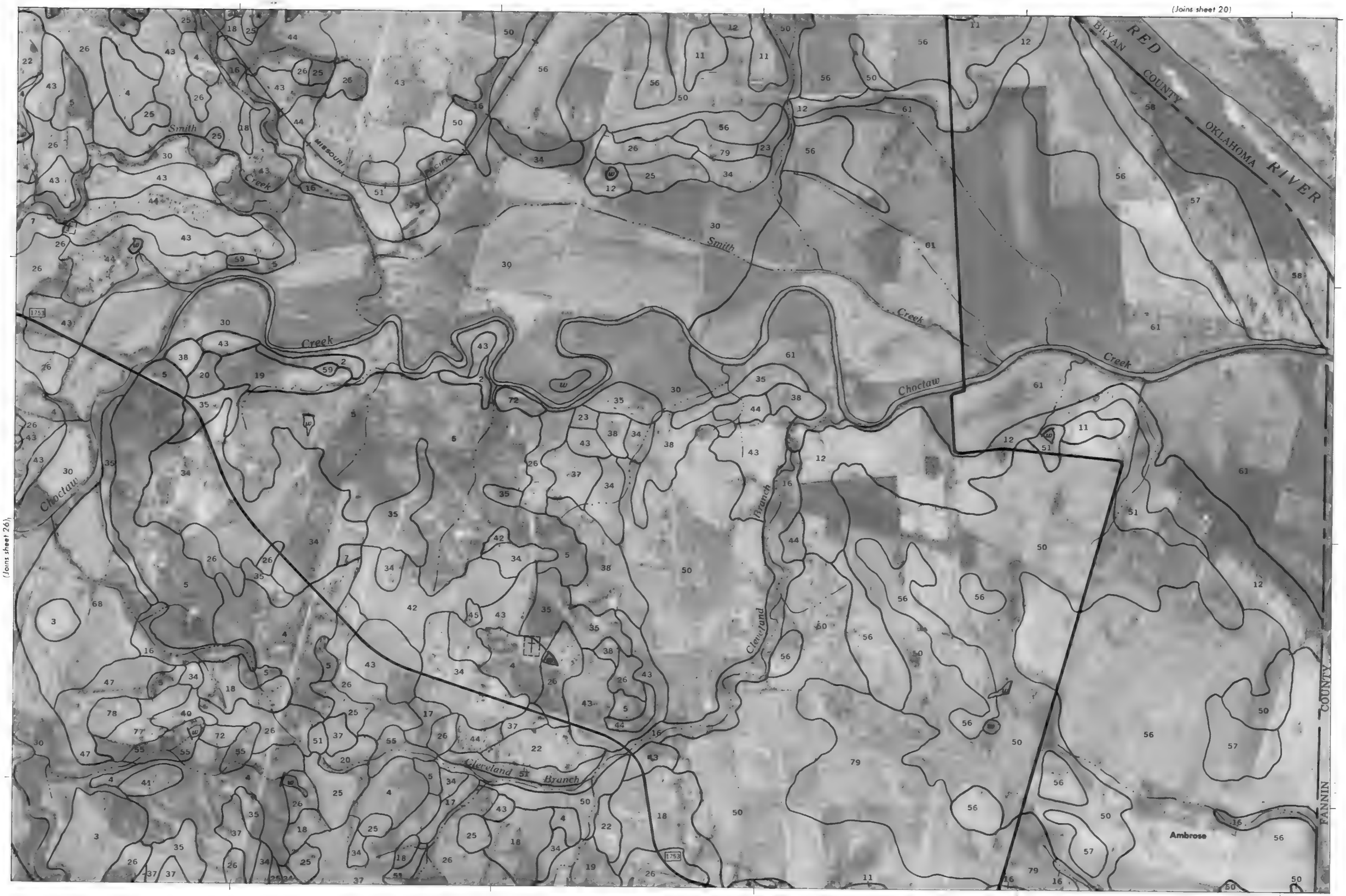
MISSOURI KANSAS TEXAS

(Joins sheet 25)

(Joins sheet 27)

(Joins sheet 33)

2 295 000 FEET


(Joins sheet 20)
(Joins sheet 26)
(Joins sheet 34)
RED
BRYAN
COUNTY
OKLAHOMA
RIVER
FANNIN
COUNTY
Smith
Creek
Choctaw
Creek
Cleveland
Branch
Ambrose
MISSOURI
PACIFIC
1753

27
N
1 Mile
5000 Feet
0
Scale 1:20000
1,000
,000
1,000
4,000
,000

28

N

Scale 1:20000

1 Mile 0 ½ ¾ 1

5000 Feet 0 1000 2000 3000 4000 5000

(Joins sheet 21)

2 090 000 FEET

North Fork Mineral Creek

South Fork Mineral Creek

COUNTY

COOKE

WHITESBORO

TEXAS

MISSOURI KANSAS TEXAS PACIFIC

KANSAS MISSOURI PACIFIC

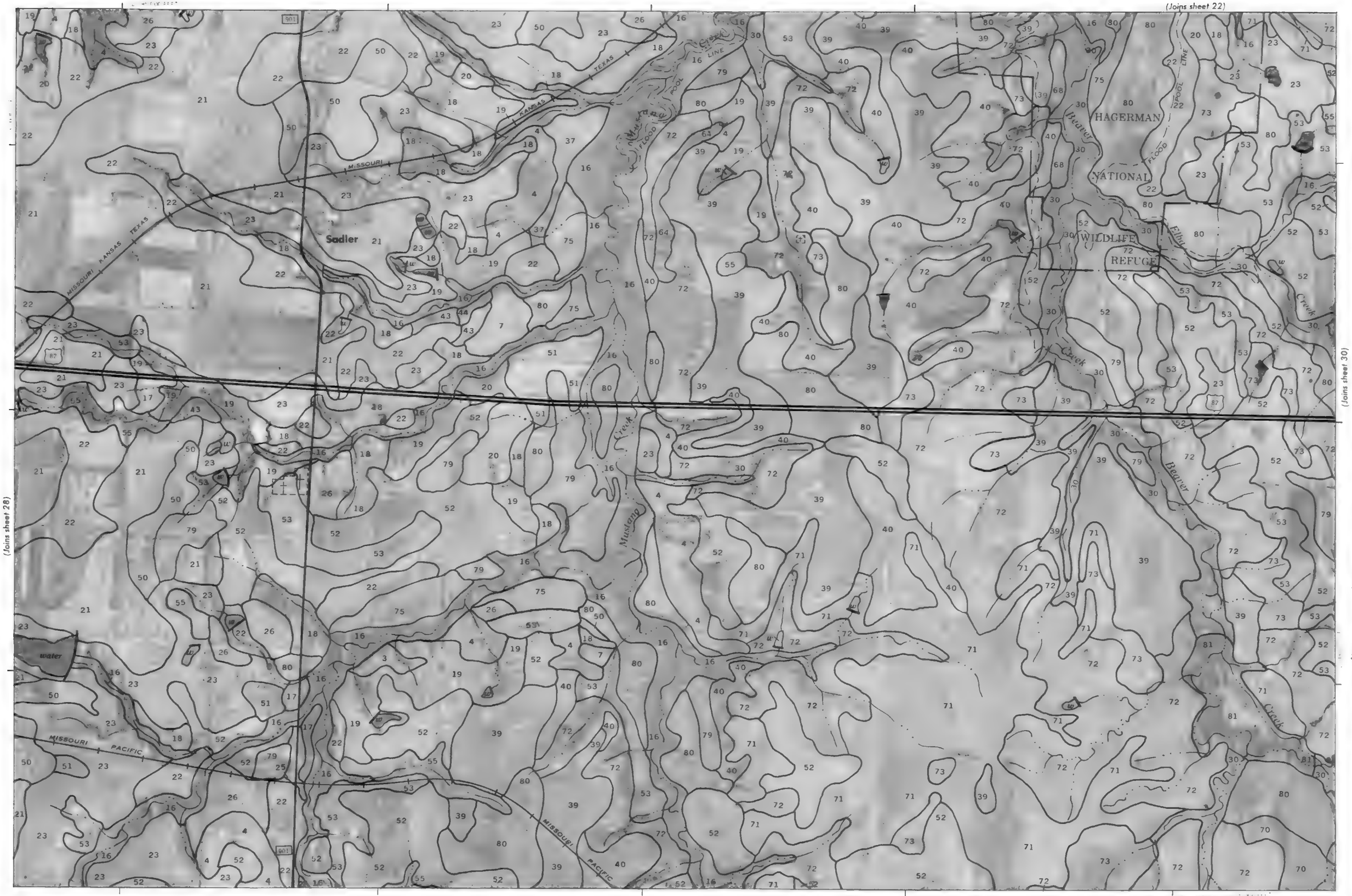
MISSOURI PACIFIC

water

(Joins sheet 35)

(Joins sheet 29)

GRAYSON COUNTY, TEXAS — SHEET NUMBER 29



29

N

1 Mile

5000 Feet

Scale 1:20000

GRAYSON COUNTY, TEXAS — SHEET NUMBER 30

30

N

(Joins sheet 23)

2 240 000 FEET

(Joins sheet 31)

1 Mile

5 000 Feet

Scale 1:20000

(Joins sheet 29)

Martin Branch

Harris Creek

Elba Creek

Bluewl Creek

water

2 220 000 FEET

(Joins sheet 37)

(Joins sheet 24)

(Joins sheet 30)

(Joins sheet 32)

(Joins sheet 38)

Sand Creek

Post Oak Creek

Post Oak Creek

Cruck

SHERMAN

1417

82

31

N

1 Mile

5000 Feet

Scale 1:20000

GRAYSON COUNTY, TEXAS — SHEET NUMBER 32

32

N

1 Mile

5,000 Feet

Scale 1:20000

(Joins sheet 25)

(Joins sheet 31)

(Joins sheet 39)

(Joins sheet 33)

SHERMAN

TEXAS

KANSAS

MISSOURI

PACIFIC

SOUTHERN

Calf Creek

GRAYSON COUNTY, TEXAS — SHEET NUMBER 33

33

N

(Joins sheet 26)

(Joins sheet 32)

(Joins sheet 34)

(Joins sheet 40)

Jack Branch

Choctaw Creek

Cull Creek

MISSOURI PACIFIC

1 Mile

5000 Feet

Scale 1:20000

GRAYSON COUNTY, TEXAS — SHEET NUMBER 34

34

N

(Joins sheet 27)

(Joins sheet 33)

(Joins sheet 41)

1 Mile

5000 Feet

Scale 1:20000

Ambrose

FANNIN COUNTY

Corneliuson Creek

Mill Creek

MISSOURI KANSAS & TEXAS

GRAYSON COUNTY, TEXAS — SHEET NUMBER 35

35

N

2 170 000 FEET

720 000 FEET

(Joins sheet 28)

COOKE COUNTY

TEXAS

KANSAS

MISSOURI

PACIFIC

WHITESBORO

Crossing

Creek

Creek

Creek

MISSOURI PACIFIC

COOKE COUNTY

(Joins sheet 36)

1 Mile

5000 Feet

0 1 2 3 4 5000

Scale 1:20000

705 000 FEET

2 190 000 FEET

(Joins sheet 42)

GRAYSON COUNTY, TEXAS — SHEET NUMBER 36

36

N

(Joins sheet 29)

2 215 000 FEET

MISSOURI PACIFIC

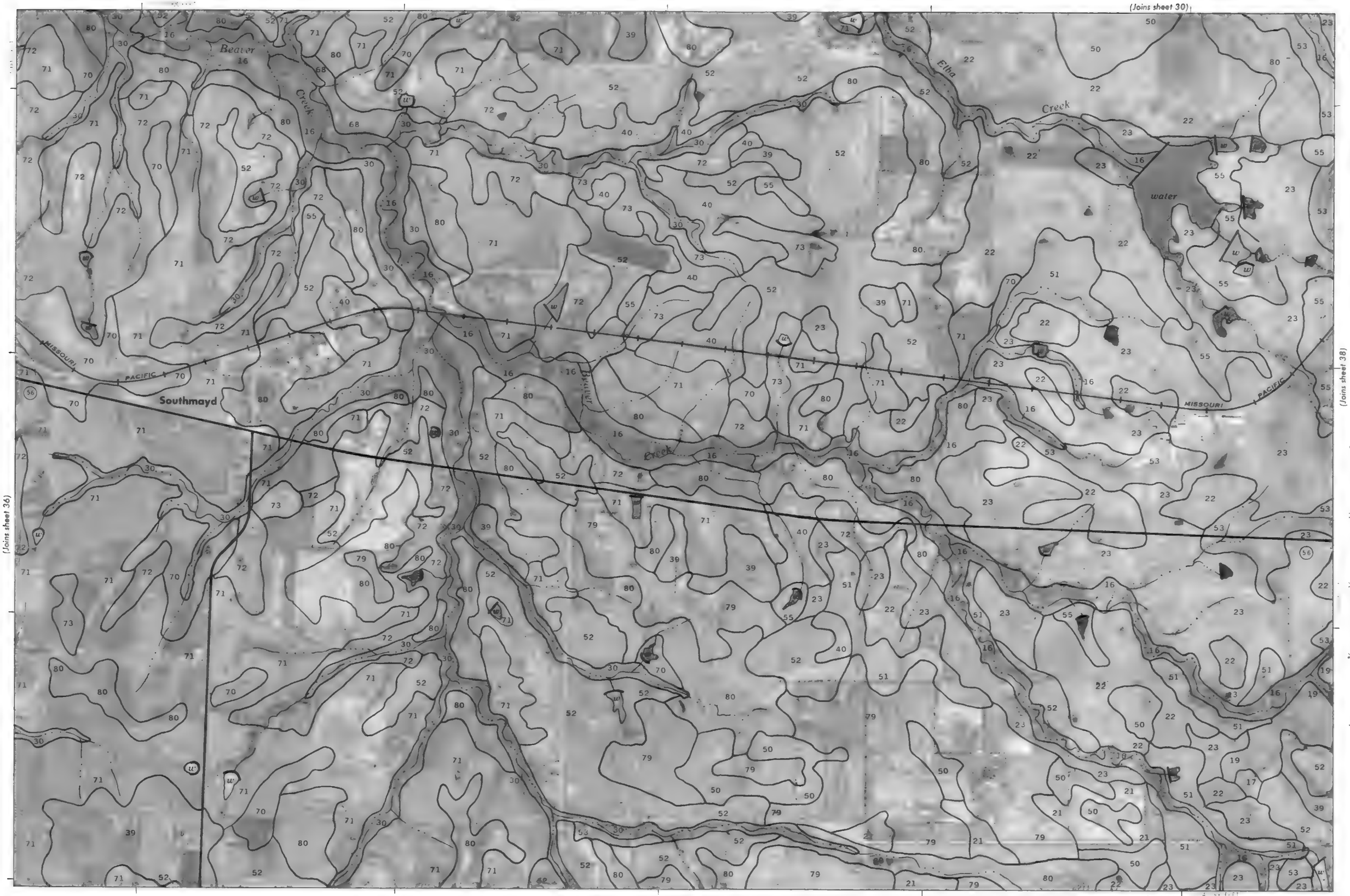
(Joins sheet 35)

(Joins sheet 37)

1 Mile 5000 Feet

Scale 1:20000

(Joins sheet 43)


(Joins sheet 30)
Beaver Creek
Elba Creek
water
MISSOURI PACIFIC
Southmayd
Brewer Creek
(Joins sheet 36)
(Joins sheet 38)
(Joins sheet 44)
37
N
1 Mile
5000 Feet
Scale 1:20000

38

N

1 Mile

5,000 Feet

0 0

Scale 1:20000

1 1,000 2,000 3,000 4,000 5,000

(Joins sheet 31)

(Joins sheet 37)

(Joins sheet 45)

(Joins sheet 39)

2 265 000 FEET

SHERMAN

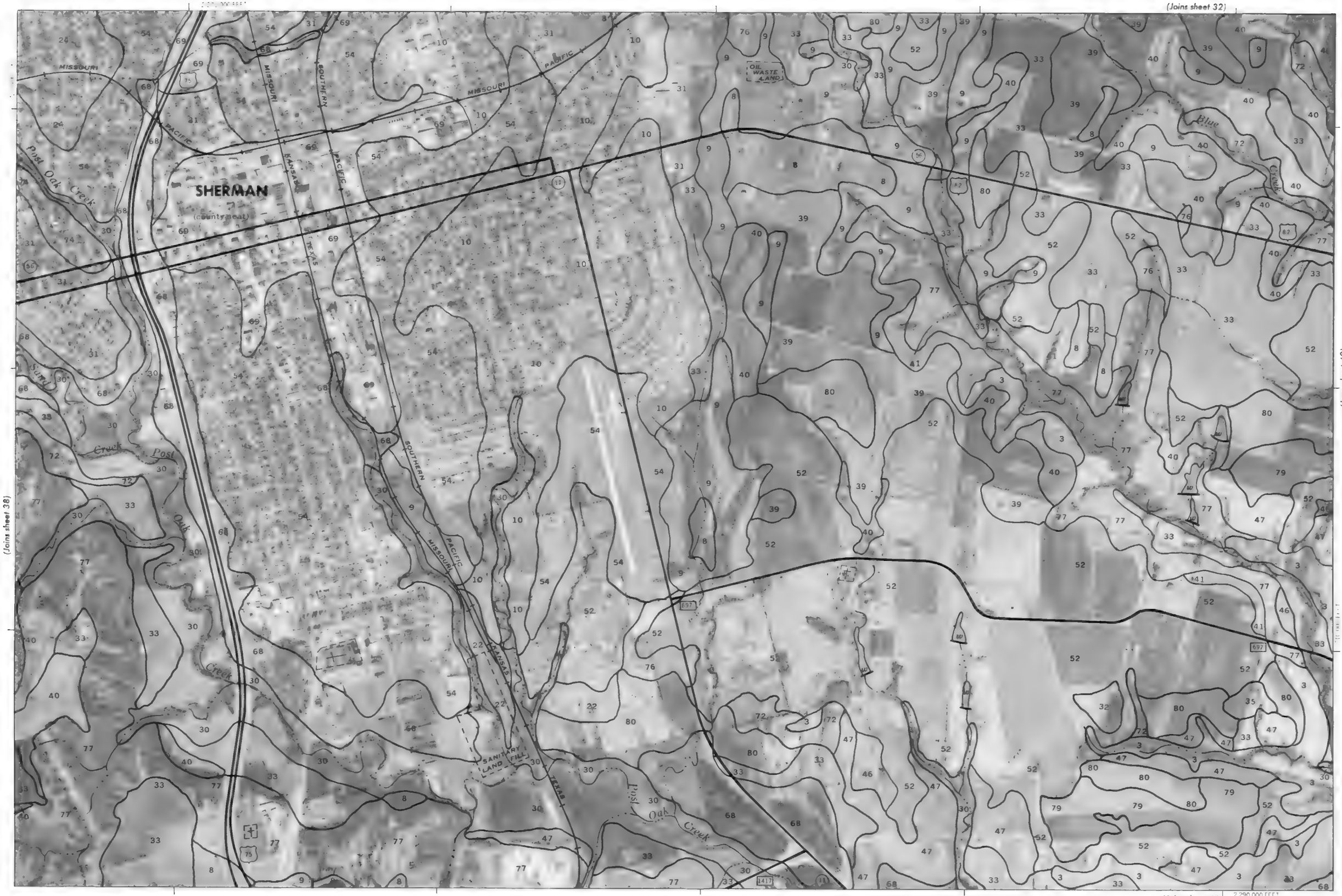
Post Oak Creek

Sand Creek

PACIFIC

MISSOURI

GRAYSON COUNTY, TEXAS — SHEET NUMBER 39



GRAYSON COUNTY, TEXAS — SHEET NUMBER 40

(40)

N

(Joins sheet 33)

(Joins sheet 41)

(Joins sheet 47)

(Joins sheet 39)

1 Mile 5000 Feet

Scale 1:20000

0 0 1000 2000 3000 4000 5000

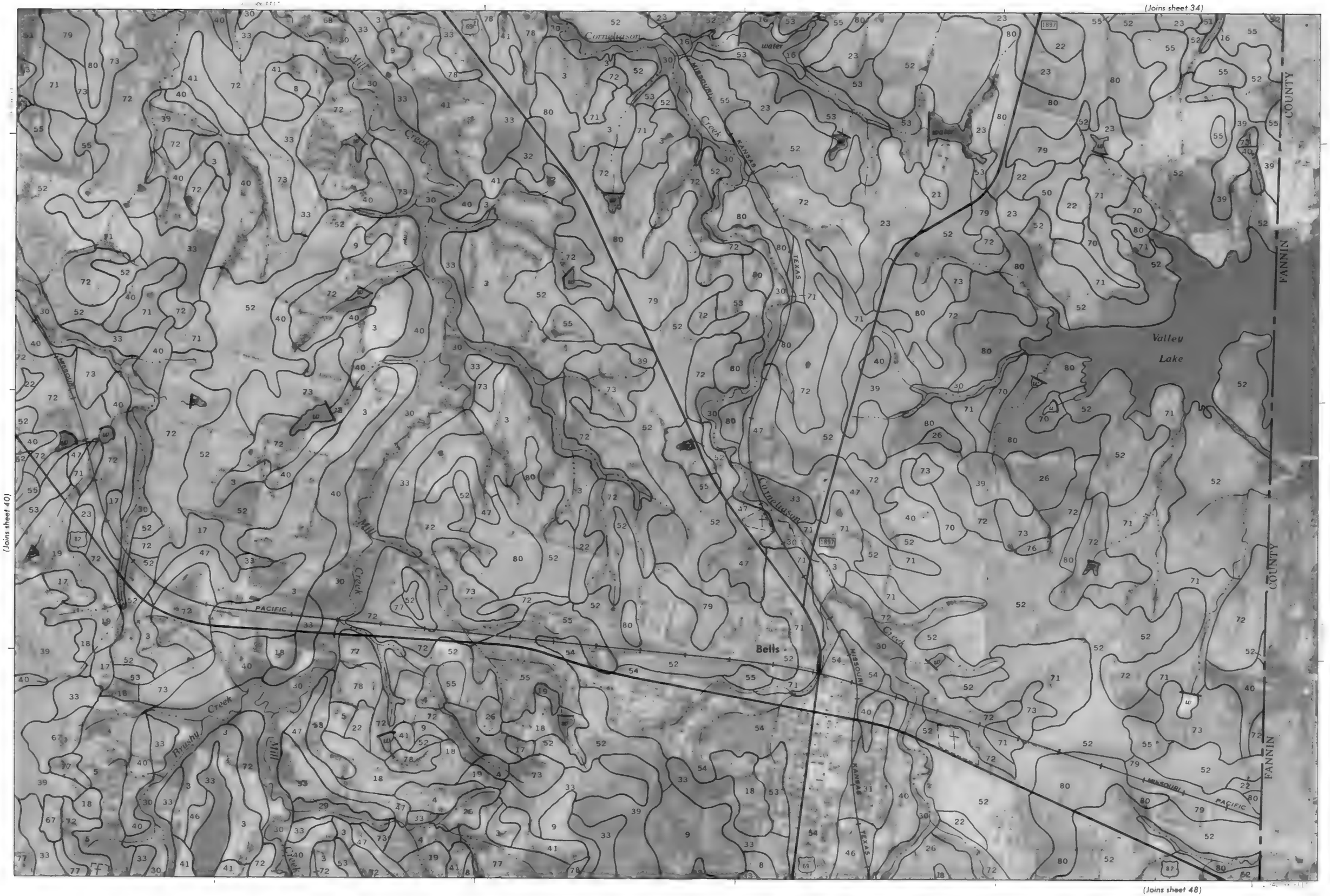
Boddie

Blue Creek

Choctaw Creek

Missouri Pacific

water


(Joins sheet 34)
(Joins sheet 40)
(Joins sheet 48)
Corruhuson
Mill Creek
Brushy Creek
Bells
Valley Lake
FANNIN COUNTY
PACIFIC
MISSOURI
KANSAS
TEXAS
water
1897
41
N
1 Mile
5000 Feet
Scale 1:20000

42

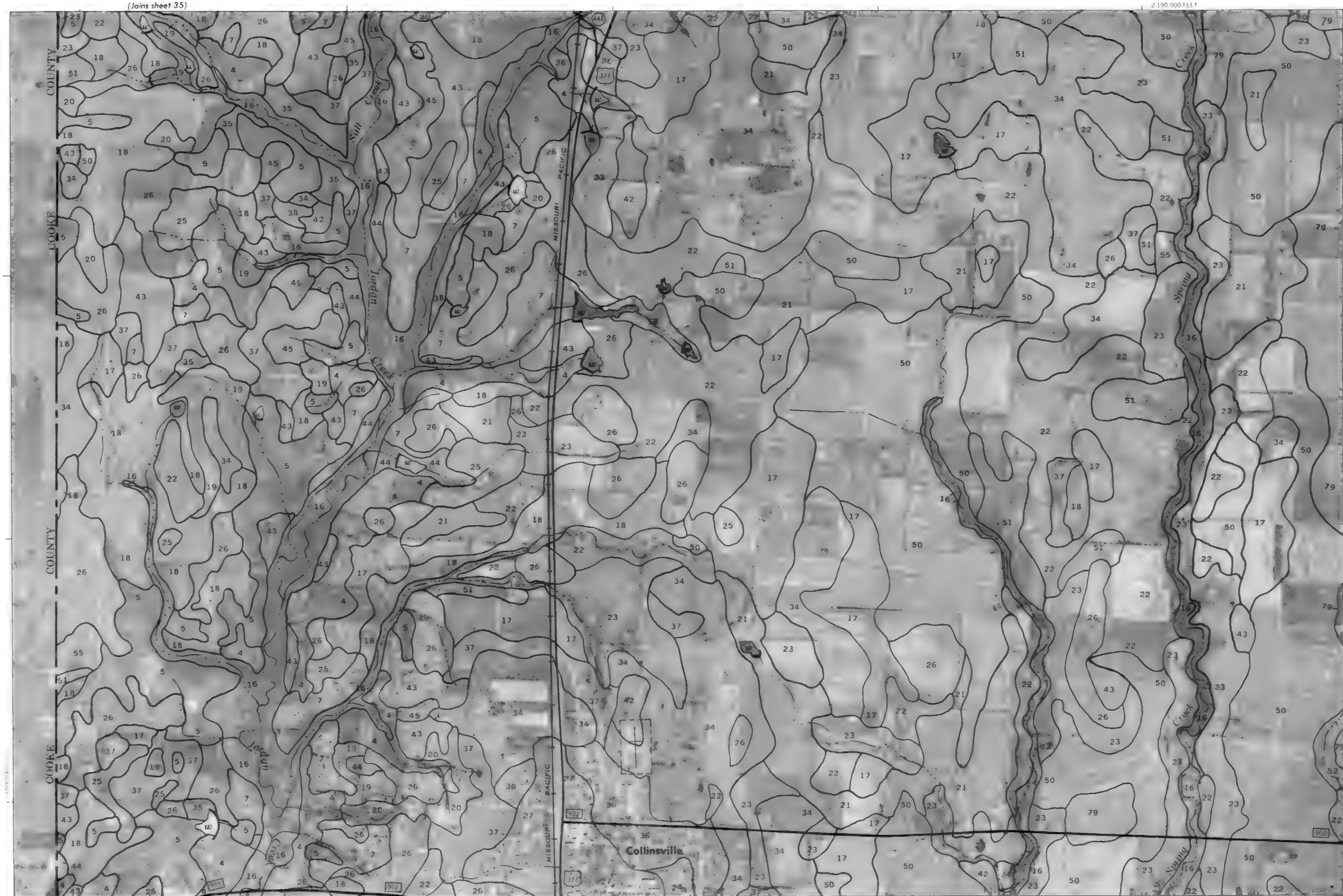
N

1 Mile

5000 Feet

Scale 1:20000

(Joins sheet 35)



(Joins sheet 43)

(Joins sheet 49)

(Joins sheet 36)

(Joins sheet 42)

(Joins sheet 44)

(Joins sheet 50)

43

N

1 Mile
5 000 Feet
0
Scale · 1 : 20000

GRAYSON COUNTY, TEXAS — SHEET NUMBER 44

44

N

(Joins sheet 37)

40 000 FEET

Beaver Creek

Range Creek

Range Creek

(Joins sheet 43)

(Joins sheet 45)

2 220 000 FEET

(Joins sheet 51)

1 Mile

5000 Feet

0

Scale · 1 : 20000

1000

2000

3000

4000

5000

GRAYSON COUNTY, TEXAS — SHEET NUMBER 45

45

N

(Joins sheet 38)

(Joins sheet 44)

(Joins sheet 46)

(Joins sheet 52)

Chactaw Creek

South Branch

South Branch

Choctaw Creek

ST LOUIS

SAN FRANSISCO

1 Mile

5000 Feet

Scale 1:20000

46

N

(Joins sheet 39)

2 290 000 FEET

1 Mile
5000 Feet
0
0
Scale 1:20000
¼
⅛
⅓
⅜
1000
2000
3000
4000
5000

(Joins sheet 45)

(Joins sheet 47)

(Joins sheet 53)

2 270 000 FEET

Post Oak Creek
Choctaw Creek
Cedar Creek
SOUTHERN PACIFIC
SAN FRANCISCO
ST LOUIS
water

(Joins sheet 40)

(Joins sheet 46)

(Joins sheet 48)

(Joins sheet 54)

47

N

1 Mile

5,000 Feet

Scale 1:20000

0 ¼ ½ ¾ 1

5000 4000 3000 2000 1000 0

Choctaw Creek

water

Brushy Creek

Westland Creek

48

N

(Joins sheet 41)

(Joins sheet 47)

(Joins sheet 55)

1 Mile 5000 Feet

Scale 1:20000

2 340 000 FEET

2 320 000 FEET

Brushy Creek

Mill Creek

Hesthurst Creek

Mill Creek

MISSOURI

KANSAS

TEXAS

FANNIN COUNTY

(Joins sheet 42)

(Joins sheet 50)

(Joins sheet 56)

COOKE COUNTY

COOKE COUNTY

Jordan Creek

Timber Creek

Jordan Creek

Spring Creek

Hog Creek

Spring Creek

Hog Creek

PACIFIC

MISSOURI

PACIFIC

MISSOURI

902

902

377

377

49

N

1 Mile

5000 Feet

Scale 1:20000

GRAYSON COUNTY, TEXAS — SHEET NUMBER 50

50

N

(Joins sheet 43)

2 215 000 FEET

Ethel

Hog Creek

Case Creek

Range Creek

Runnel

1 Mile

5000 Feet

Scale 1:20000

(Joins sheet 49)

(Joins sheet 51)

2 195 000 FEET

(Joins sheet 57)

(Joins sheet 44)

(Joins sheet 50)

(Joins sheet 52)

(Joins sheet 58)

2'240 000 FEET

51

N

1 Mile

5000 Feet

Scale 1:20000

52

N

1 Mile
5,000 Feet
Scale 1:20000
0 0 1000 2000 3000 4000 5000

(Joins sheet 45)

(Joins sheet 51)

(Joins sheet 53)

(Joins sheet 59)

SAN FRANSISCO

ST LOUIS

Dorchester

Trinity River

East Fork

Squirrel Creek

802

(Joins sheet 46)

(Joins sheet 52)

(Joins sheet 54)

(Joins sheet 60)

53

N

1 Mile

5000 Feet

Scale 1:20000

SOUTHERN PACIFIC

Howe

Cedar Creek

GRAYSON COUNTY, TEXAS — SHEET NUMBER 54

54

N

(Joins sheet 47)

(Joins sheet 53)

(Joins sheet 55)

(Joins sheet 61)

1 Mile
5,000 Feet
Scale 1:20000

water

White Mound

Tom Bean

2729

697

902

120

(Joins sheet 48)

(Joins sheet 54)

(Joins sheet 62)

2 320 000 FEET

2 340 000 FEET

55

N

1 Mile

5000 Feet

0

0

Scale 1:20000

1

5000

½

4000

½

3000

¾

2000

¼

1000

0

water

Mill

Creek

MISSOURI

KANSAS

TEXAS

COUNTY

FANNIN

Whitewright

697

69

151

898

11

GRAYSON COUNTY, TEXAS — SHEET NUMBER 56

56

N

(Joins sheet 49)

COOKE COUNTY

COOKE COUNTY

Jordan Creek

du Bois Creek

Isle du Bois Creek

Range Creek

Hog Creek

Spring Creek

Range Creek

Creek

water

PACIFIC

MISSOURI

PACIFIC

MISSOURI

377

121

Tioga 24

1 Mile

5000 Feet

Scale 1:20000

(Joins sheet 63)

(Joins sheet 57)

(Joins sheet 50)

(Joins sheet 56)

(Joins sheet 58)

(Joins sheet 64)

Range

Creek

Creek

Creek

Creek

Bear Creek

Buck Creek

water

121

121

57

N

1 Mile

5000 Feet

Scale 1:20000

1000 0 2000 3000 4000 5000

GRAYSON COUNTY, TEXAS — SHEET NUMBER 58

58

N

(Joins sheet 51)

2 240 000 FEET

Buck Creek

Elm Creek

Little Creek

water

SAN FRANCISCO

ST LOUIS

289

1 Mile

5000 Feet

Scale 1 : 20000

0 1/2 1 2 3 4 5

(Joins sheet 57)

(Joins sheet 59)

(Joins sheet 65)

59

N

1 Mile

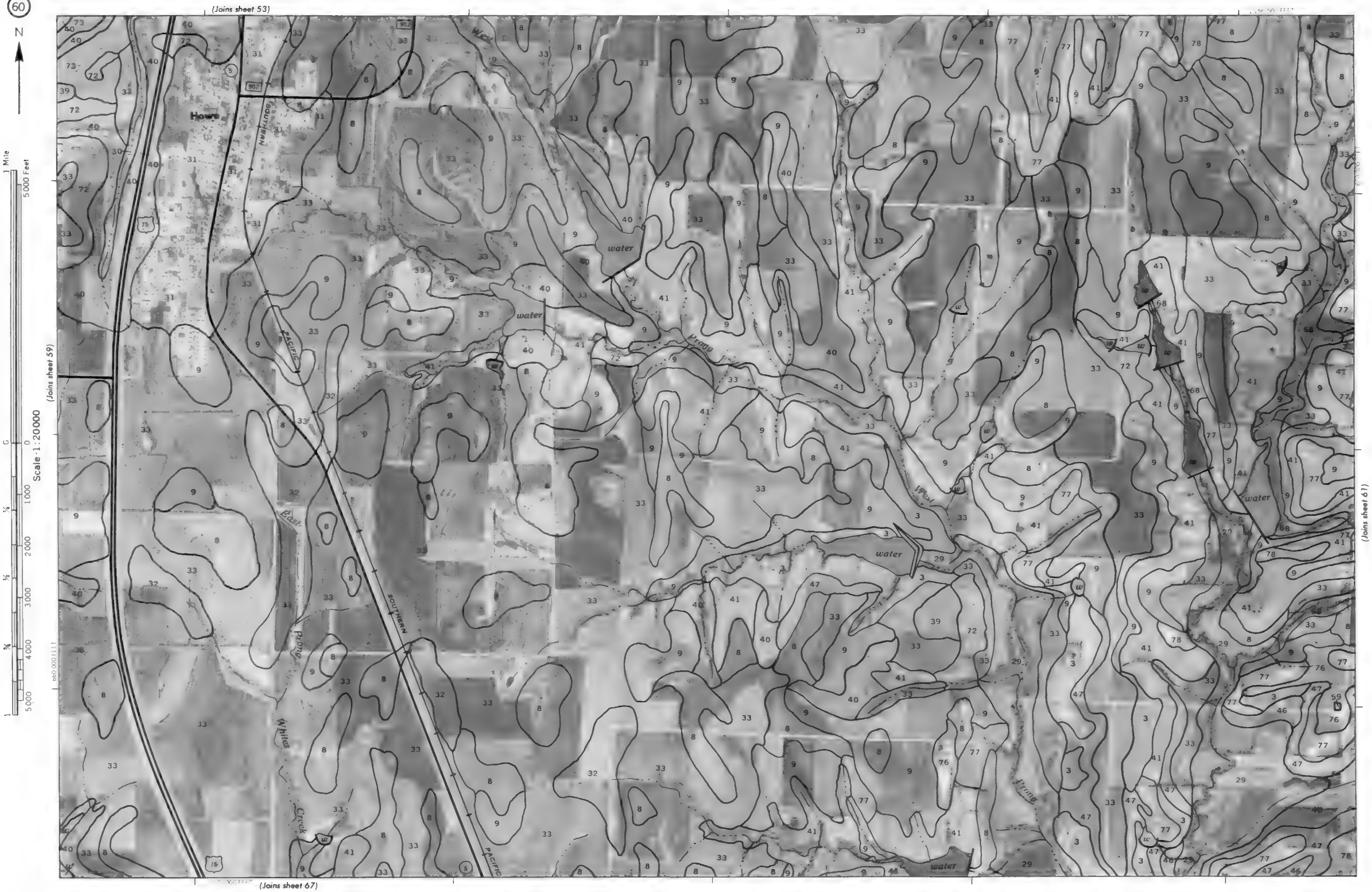
5,000 Feet

Scale 1:20000

0 ¼ ½ ¾ 1

0 1000 2000 3000 4000 5000

GRAYSON COUNTY, TEXAS — SHEET NUMBER 60



GRAYSON COUNTY, TEXAS — SHEET NUMBER 61

61

N

(Joins sheet 54)

(Joins sheet 60)

(Joins sheet 62)

(Joins sheet 68)

water

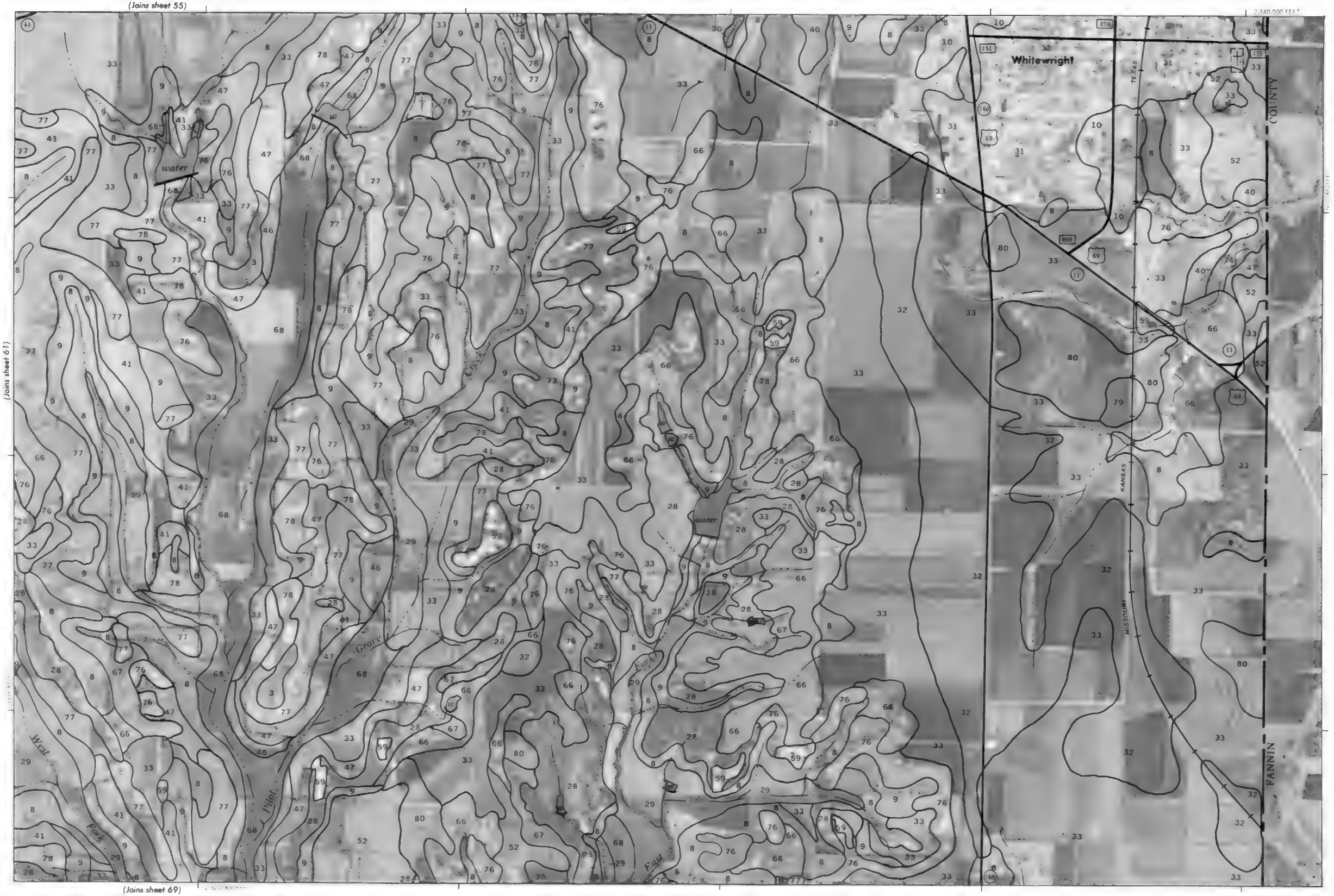
East Fork

West Fork

Scale 1:20000

1 Mile

5000 Feet


(Joins sheet 55)
(Joins sheet 61)
(Joins sheet 69)
7 340 000 FEET
Whitewright
TEXAS
COUNTY
water
Creek
Grove
Fork
Pilot
West
Fork
East
KANSAS
MISSOURI
FANNIN
N
1 Mile
5000 Feet
0
Scale 1:20000
0
1000
2000
3000
4000
5000

GRAYSON COUNTY, TEXAS — SHEET NUMBER 63

63

N

(Joins sheet 56)

(Joins sheet 64)

(Joins inset, sheet 70)

2 170 000 FEET

2 190 000 FEET

COUNTY

COOKE

Buck Creek

Pierce Spring Branch

Missouri Pacific

Hoga

30 Creek

1 Mile

5,000 Feet

Scale 1:20000

GRAYSON COUNTY, TEXAS — SHEET NUMBER 64

64

N

(Joins sheet 57)

2 215 000 FEET

(Joins sheet 63)

(Joins sheet 65)

2 195 000 FEET

(Joins sheet 70)

1 Mile 5 000 Feet

Scale 1:20000

0 0

1/4 1 000

1/2 2 000

3/4 3 000

1 4 000

1 5 000

Creek

Buck

Bear

water

2 220 000 FEET

(Joins sheet 58)

(Joins sheet 64)

(Joins sheet 66)

(Joins sheet 71)

N

1 Mile

5 000 Feet

Scale 1:20000

0 ¼ ½ ¾ 1

0 1 000 2 000 3 000 4 000 5 000

Elm Creek

Little Elm Creek

Stanley Creek

Gunter

Gunter Lake

water

SAN FRANCISCO

ST LOUIS

AND

121

289

66

N

1 Mile

5000 Feet

Scale · 1:20000

(Joins sheet 59)

(Joins sheet 65)

(Joins sheet 67)

(Joins sheet 72)

water

East Fork Trinity River

Squirrel Creek

Stanley Creek

Squirrel Creek

Griffes Creek

Elmont

GRAYSON COUNTY, TEXAS — SHEET NUMBER 67

67

N

(Joins sheet 60)

(Joins sheet 66)

(Joins sheet 68)

(Joins sheet 73)

SOUTHERN PACIFIC

East Prong

West Prong

Whites Creek

water

Van Alstyne

1 Mile

5000 Feet

Scale 1:20000

68

N

(Joins sheet 61)

(Joins sheet 67)

(Joins sheet 69)

(Joins sheet 74)

Prong

East Prong

water

Cannon

2729

121

1 Mile

5000 Feet

Scale 1 : 20000

0 1000 2000 3000 4000 5000

(Joins sheet 62)

(Joins sheet 68)

(Joins sheet 75)

69

N

1 Mile

5,000 Feet

0

Scale 1:20000

Pilot Grove

water

water

West Fork

Pilot Creek

Grouse Fork

East Fork

Pilot Grove Creek

Conner Creek

Conner Creek

Creek

Creek

Conner Creek

Desert Creek

COUNTY

FANNIN

GRAYSON COUNTY, TEXAS — SHEET NUMBER 70

70

N

1 Mile

5000 Feet

Scale · 1 : 20000

(Joins sheet 64)

2 215 000 FEET

640 000 FEET

(Joins lower right)

(Joins sheet 71)

DENTON COUNTY

DENTON COUNTY

COLLIN COUNTY

water

Elm Creek

Little Elm

2 195 000 FEET

(Joins sheet 63)

2 190 000 FEET

637 000 FEET

639 000 FEET

(Joins upper left)

COOKE COUNTY

DENTON COUNTY

5000 AND 2000 FOOT GRID

GRAYSON COUNTY, TEXAS — SHEET NUMBER 71

71

N

2 220 000 FEET

640 000 FEET

(Joins sheet 65)

(Joins sheet 70)

(Joins sheet 72)

Creek

Elm

Little

water

water

SAN FRANCISCO AND ST LOUIS

289

COLLIN

COUNTY

2 240 000 FEET

1 Mile

5000 Feet

0 0

¼ 1000

½ 2000

¾ 3000

1 4000

5000

Scale 1:20000

GRAYSON COUNTY, TEXAS — SHEET NUMBER 72

72

N

(Joins sheet 66)

2 265 000 FEET

640 000 FEET

(Joins sheet 71)

(Joins sheet 73)

625 000 FEET

2 245 000 FEET

Scale · 1:20000

1 Mile

5000 Feet

0

Stanley Creek

Squirrel Creek

Whites Creek

Prairie Creek East

Trinity River

West Fork

water

COLLIN COUNTY

GRAYSON COUNTY, TEXAS — SHEET NUMBER 73

73

N

2 270 000 FEET

(Joins sheet 67)

640 000 FEET

(Joins sheet 72)

(Joins sheet 74)

Van Alstyne

Prong

Whites Creek

East

Hurricane Creek

SOUTHERN

PACIFIC

COLLIN

COUNTY

625 000 FEET

2 290 000 FEET

1 Mile

5 000 Feet

Scale 1:20000

74

N

Scale · 1 : 20000

1 Mile 5000 Feet

0 0 ¼ ½ ¾ 1

1000 2000 3000 4000 5000

(Joins sheet 68)

2 315 000 FEET

640 000 FEET

(Joins sheet 73)

(Joins sheet 75)

625 000 FEET

2 295 000 FEET

COLLIN COUNTY

West Prong

East Prong

Prong Creek

Sister Grove

water

9F33

3135

GRAYSON COUNTY, TEXAS — SHEET NUMBER 75

2 320 000 FEET

640 000 FEET

(Joins sheet 69)

(Joins sheet 74)

COLLIN COUNTY

FANNIN COUNTY

Pilot Grove Creek

Sonner Creek

Creek

Desert Creek

water

625 000 FEET

2 340 000 FEET

75

N

1 Mile

5 000 Feet

Scale 1:20000